STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
FRED G. STEVENOT, Director
DIVISION OF MINES AND MINING
FERRY BUILDING, SAN FRANCISCO
LLOYD L. ROOT — State Mineralogist

San Francisco] — BULLETIN No. 100 — [September, 1927

CALIFORNIA MINERAL PRODUCTION FOR 1926

By
WALTER W. BRADLEY

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LETTER OF TRANSMITTAL.

September, 1927.

To His Excellency, THE HONORABLE C. C. YOUNG,
Governor of the State of California.

SIR: I have the honor to herewith transmit Bulletin No. 100 of the State Division of Mines and Mining, being the annual report of the statistics of the mineral production of California.

The remarkable variety, total valuation, and wide distribution of many of our minerals revealed herein show California's importance as a producer of commercial minerals among the states of the Union.

Respectfully submitted.

LLOYD L. ROOT,
State Mineralogist.

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INTRODUCTION.

It is the endeavor of the staff of the State Mining Bureau (now Division of Mines and Mining of the State Department of Natural Resources), in these annual reports of the mineral industries of California, to so compile the statistics of production that they will be of actual use to producers and to those interested in the utilization of the mineral products of our state, while at the same time keeping the individual's data confidential. In addition to the mere figures of output, we have included descriptions of the uses and characteristics of many of the materials, as well as a brief mention of their occurrences.

The compilation of accurate and dependable figures is an extremely difficult undertaking, and the State Mineralogist takes the opportunity of here expressing his appreciation of the cooperation of the producers in making this work possible. A fuller appreciation of the value of early responses to the requests sent out in January will result in earlier completion of the manuscript. Statistics lose much of their value if their publication is unnecessarily delayed.

Some of the data relative to properties and uses of many of the minerals herein described are repeated from preceding reports, as it is intended that this annual statistical bulletin shall be somewhat of a compendium of information on California's commercial minerals and their utilization.

LLOYD L. ROOT,
State Mineralogist.

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MINERAL INDUSTRY, CALIFORNIA, 1926.

DATA COMPILED FROM DIRECT RETURNS FROM PRODUCERS IN ANSWER TO INQUIRIES SENT OUT BY THE CALIFORNIA STATE DIVISION OF MINES AND MINING, FERRY BUILDING, SAN FRANCISCO, CALIFORNIA.

CHAPTER ONE.

The total value of the mineral output of California for the year 1926 was $450,330,856, being an increase of $15,811,196 over the 1925 total of $434,519,660. There were fifty-six different mineral substances, exclusive of a segregation of the various stones grouped under gems; and all of the fifty-eight counties of the state contributed to the list.

As revealed by the data following, the salient features of 1926 compared with the preceding year were: The considerable increase in value of both the petroleum and natural gas yields; and material advances also made by miscellaneous stone, zinc, cement, soda, salt, and pottery clays. Decreases were registered by gold, copper, silver, brick, granite, magnesite. There were a number of other minor variations. The net result was an increase in the grand total for all groups of nearly sixteen million dollars, as stated above. Petroleum accounted for an increase of $14,936,848 in total value, due to advanced prices, in spite of a drop from 232,492,147 barrels to 224,673,281 barrels in quantity, or a difference of 7,818,866 barrels.

Of the metals: Zinc increased from 11,546 602 pounds, worth $877,542, to 20,447,559 pounds, worth $1,533,568, due to heavy shipments of concentrates to Belgium; lead from 7,352,422 pounds and $639,661 to 8,067,873 pounds and $645,429. Copper decreased from 46,968,499 pounds, valued at $6,669,527, to 33,521,544 pounds and $4,693,014; gold from $13,065,330 to $11,923,481; silver from 3,054,416 fine ounces, worth $2,119,765, to 2,022,460 fine ounces and $1,262,015; quicksilver from 7683 flasks and $621,831 to 5892 flasks and $516,382, though the average price per flask received by the producers advanced from $80.81 for 1925 to $87.64 for the year 1926. Though the gold yield decreased a million dollars in value, California continues to account for approximately 30 per cent of the gold output of the United States.

Of the structural group: Miscellaneous stone advanced from $17,409,854 to $19,859,873 in value; cement from 13,206,630 barrels, worth $25,043,335, to 13,797,173 barrels and $25,269,678, the average price per barrel dropping slightly. Granite dropped from a valuation of $1,853,859 to $655,332; brick and hollow building-blocks or tile from $7,503,976 to $7,026,124; magnesite from 64,623 tons, crude, valued at

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$872,944, to 50,915 tons and $587,642. Of the 'industrial' and 'salines' groups, as is usually the case, there were a number of fluctuations, the most important increase being shown by pottery clays from 537,587 tons, valued at $674,376, to 797,461 tons and $806,509.

The figures of the State Division of Mines and Mining are made up from reports received direct from the producers of the various minerals. Care is exercised in avoiding duplication, and any error is likely to be on the side of under- rather than over-estimation.

California yields commercially a greater number and variety of mineral products than any state in the United States, and probably more than any other equal area elsewhere of the earth. The total annual value of her output has been surpassed by not more than four or five others, and those usually the great coal states of east of the Mississippi. More recently California has been placed second to Pennsylvania, the leader. California was for many years the sole domestic source of borax, chromite and magnesite and in which we still lead. We lead all other states in the production of gold, quicksilver, and platinum; and have alternated in the lead with Colorado in tungsten, and with Oklahoma in petroleum.

The mineral industries, not only in California, but throughout the country, have reached quite a different phase from that of the old gold-rush days more than fifty years ago. A broader and more intimate status has been attained, touching practically every avenue of domestic and commercial endeavor. As quoted in a former report[1] of the freight handled by the railroads of the country, the products of the mines represent 51.33 per cent. While gold, in which California still leads the United States, is still important, other metals and even nonmetals have superseded it in annual value. The greatest commercial developments proportionately in California in recent years have taken place among the industrial and structural minerals, not to mention petroleum, which leads all others in value. This introduces a new factor which requires study and attention—that of marketing. The gold miner could, and still does, take his metal to the mint and receives its equivalent in the 'coin of the realm'; and he knows from day to day and year to year, without variation, just how much each ounce of gold will bring in that coin, though its equivalent in other commodities varies according to economic conditions. Marketing and competition, however, are vital factors in the industrial and structural groups.

Under the caption "Mining enters the new competition," the United States Chamber of Commerce recently issued the following statement:

"Mining, no less than manufacturing, is being caught up in the swirl of the new competition.

"With the growth and development of our industries, there has come an intensified struggle between commodities for markets. The development of new uses and the demonstration of the adaptibility of certain materials has broken down many barriers and enlarged the field so that we find competition between metals and between minerals, copper versus aluminum, nickel versus chromium, sulphur versus pyrite, zirconium oxide substituting for tin oxide in enamels, titanium oxide for zinc and lead oxides in pigments, duco replacing mineral pigments, antimony substituting for tin in cable sheathings, chromite in place of magnesite for refractories.

[1] Cal. Sate Min. Bur., Bulletin 96, p. 12, 1925.

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There is also competition between mine products and forest products, concrete and steel versus lumber and timber, gypsum board versus celotex.

"The mine owner is no longer merely interested in extracting metals and minerals from the earth as cheaply as possible but in finding new markets and in developing new uses for his products. He has to meet the attacks of organized competition and few mine owners are strong enough to meet them successfully alone."

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By Substances.

The following table shows the comparative yield of mineral substances of California for 1925 and 1926, as compiled from the returns received at the State Division of Mines and Mining, San Francisco, in answer to inquiries sent to producers.

Substance	1925 Amount		1925 Value	1926 Amount		1926 Value	Increase+ Decrease— Value
Barytes	----------		----------	4,978	tons	$38,165	$38,165+
Bituminous rock	*		*	3,863	tons	21,577	* +
Borates	46,124	tons	$1,526,938	47,605	tons	1,625,298	98,360+
Brick and hollow building tile	----------		7,503,976	----------		7,026,124	477,852—
Cement	13,206,630	bbls.	25,043,335	13,797,173	bbls.	25,269,678	226,343+
Chromite	591	tons	10,912	395	tons	7,063	3,849—
Clay (pottery)	537,587	tons	674,376	797,461	tons	806,509	132,133+
Coal	730	tons	3,880	1,100	tons	5,000	1,120+
Copper	46,968,499	lbs.	6,669,527	33,521,544	lbs.	4,693,014	1,976,513—
Dolomite	42,850	tons	104,900	68,640	tons	119,313	14,413+
Feldspar	8,165	tons	59,615	7,300	tons	56,400	3,215—
Fullers earth	5,280	tons	91,842	23,552	tons	250,192	158,350+
Gems	----------		10,663	----------		9,049	1,614—
Gold	----------		13,065,330	----------		11,923,481	1,141,849—
Granite	----------		1,853,859	----------		655,332	1,198,527—
Gypsum	107,613	tons	172,444	114,868	tons	211,337	38,893+
Lead	7,352,422	lbs.	639,661	8,067,873	lbs.	645,429	5,768+
Lime	61,922	tons	685,528	63,568	tons	670,837	14,691—
Limestone	319,977	tons	494,525	108,795	tons	367,501	127,024—
Magnesite	64,623	tons	872,944	50,915	tons	587,642	285,302—
Magnesium salts	4,221	tons	132,553	4,881	tons	124,470	8,083—
Manganese ore	832	tons	19,450	235	tons	4,700	14,750—
Marble	35,664	cu. ft.	116,105	34,806	cu. ft.	119,999	3,894+
Mineral paint	669	tons	6,969	569	tons	5,846	1,123—
Mineral water	12,115,072	gals.	1,230,455	14,074,877	gals.	1,171,550	58,905—
Natural gas	194,719,924	M cu. ft.	15,890,082	214,549,477	M cu. ft.	19,465,347	3,575,265+
Onyx and travertine	19,940	cu. ft.	16,120	15,090	cu. ft.	7,575	8,545—
Petroleum	232,492,147	bbls.	330,609,829	224,673,281	bbls.	345,546,677	14,936,848+
Platinum	292	fine oz.	39,937	306	fine oz.	32,005	7,932—
Potash	36,355	tons	829,770	32,884	tons	812,285	17,485—
Pumice and volcanic ash	5,319	tons	32,937	7,170	tons	48,350	15,413+
Pyrites	129,500	tons	528,550	100,896	tons	466,088	62,462—
Quicksilver	7,683	flasks	621,831	5,892	flasks	516,382	105,449—
Salt	284,068	tons	949,826	311,761	tons	1,124,978	175,152+
Sandstone	14,704	cu. ft.	14,362	34,100	cu. ft.	17,500	3,138+
Silica (sand and quartz)	12,498	tons	96,780	30,010	tons	104,317	7,537+
Silver	3,054,416	fine oz.	2,119,765	2,022,460	fine oz.	1,262,015	857,750—
Slate	----------		----------	----------		7,371	7,371+
Soapstone and talc	15,465	tons	239,084	17,004	tons	255,645	16,561+

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Soda	48,625 tons	947,649	63,333 tons	1,305,802	358,153 +
Stone, miscellaneous[a]		17,409,854		19,859,873	2,450,019 +
Tungsten concentrates	573 tons	348,471	441 tons	316,560	31,911 —
Zinc	11,546,602 lbs.	877,542	20,447,559 lbs.	1,533,568	656,026 +
Unapportioned		[b]1,957,484		[c]1,233,012	724,472 —
Total values		$434,519,660		$450,330,856	
Net increase					$15,811,196 +

[a] Under 'Unapportioned.'
[a] Includes macadam, ballast, rubble, riprap, paving blocks, sand, gravel, and grinding-mill pebbles.
[b] Includes calcium chloride, bituminous rock, antimony, asbestos, graphite, infusorial and diatomaceous earth, iron ore, shale oil, sillimanite-andalusite.
[c] Includes antimony, asbestos, bromine, calcium chloride, diatomaceous earth, iron ore, lithia, shale oil, sillimanite-andalusite-cyanite group.

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By Counties.

The following table shows the comparative value of the mineral production of the various counties in the state, for the years 1925 and 1926:

	1925	1926
Alameda	$2,916,506	$3,158,474
Alpine	520	450
Amador	2,625,703	2,451,500
Butte	546,178	461,945
Calaveras	1,450,618	1,809,772
Colusa	103,230	91,194
Contra Costa	2,544,179	2,610,553
Del Norte	270,582	70,464
El Dorado	352,828	302,086
Fresno	9,264,996	6,699,928
Glenn	92,288	58,391
Humboldt	719,151	706,670
Imperial	330,965	467,314
Inyo	2,585,145	2,835,834
Kern	89,400,726	83,556,074
Kings	520	720
Lake	73,348	75,693
Lassen	2,404	19,063
Los Angeles	193,180,000	194,358,926
Madera	1,377,458	425,738
Marin	434,802	527,553
Mariposa	634,862	319,724
Mendocino	16,533	15,800
Merced	80,262	192,665
Modoc	2,400	37,991
Mono	184,745	209,848
Monterey	277,721	359,993
Napa	229,172	341,571
Nevada	2,352,877	3,240,211
Orange	49,104,490	63,223,082
Placer	550,413	480,882
Plumas	4,401,508	3,572,628
Riverside	5,179,108	6,194,253
Sacramento	2,504,405	2,243,952
San Benito	2,617,396	2,400,850
San Bernardino	14,179,663	14,218,475
San Diego	1,129,757	1,241,324
San Francisco	131,158	112,193
San Joaquin	737,818	842,000
San Luis Obispo	136,477	253,294
San Mateo	1,577,513	1,893,853
Santa Barbara	4,338,431	2,583,548
Santa Clara	1,320,858	1,028,506
Santa Cruz	3,227,036	3,504,194
Shasta	4,300,449	2,886,144
Sierra	1,386,301	569,515
Siskiyou	219,626	494,151
Solano	2,678,547	1,770,820
Sonoma	160,231	222,586
Stanislaus	415,466	401,997
Sutter	397	397
Tehama	77,183	10,340
Trinity	502,289	611,797
Tulare	426,979	397,920
Tuolumne	567,248	615,998
Ventura	17,853,540	30,208,369
Yolo	23,060	20,560
Yuba	2,721,594	2,921,083
Total	$434,519,660	$450,330,856

Total Mineral Production of California, by Years.

The following tabulation gives the total value of mineral production of California by years since 1887, in which year compilation of such data by the State Mining Bureau (now Division of Mines and Mining) began. At the side of these figures the writer has placed the values of the most important metal and non-metal items—gold and petroleum.

In the same period copper made an important growth beginning with 1897 following the entry of the Shasta County mines, and more recently Plumas County. Cement increased rapidly from 1902, while crushed rock, sand and gravel as a group parallels the cement increase. Quick-

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silver has been up and down. Mineral water and salt have always been important items, but the values fluctuate. Borax has increased materially since 1896. War-time increases, 1915–1918, were shown by chromite, copper, lead, magnesite, manganese, silver, tungsten and zinc. Most of these, except silver, have since declined, though structural materials and copper increased in 1920–1924, also lead and magnesite in 1923; lead and zinc in 1925; zinc in 1926, with silver declining.

Total Mineral Production of California, by Years, Since 1887.

Year	Total value of all minerals	Gold, value	Petroleum, value
1887	$19,785,868	$13,588,614	$1,357,144
1888	19,469,320	12,750,000	1,380,666
1889	16,681,731	11,212,913	368,048
1890	18,039,666	12,309,793	384,200
1891	18,872,413	12,728,869	401,264
1892	18,300,168	12,571,900	561,333
1893	18,811,261	12,422,811	608,092
1894	20,203,294	13,923,281	1,064,521
1895	22,844,663	15,334,317	1,000,235
1896	24,291,398	17,181,562	1,180,793
1897	25,142,441	15,871,401	1,918,269
1898	27,289,079	15,906,478	2,376,420
1899	29,313,460	15,336,031	2,660,793
1900	32,622,945	15,863,355	4,152,928
1901	34,355,981	16,988,044	2,961,102
1902	35,069,105	16,910,320	4,692,189
1903	37,759,040	16,471,264	7,313,271
1904	43,778,348	19,109,600	8,317,809
1905	43,069,227	19,197,043	9,007,820
1906	46,776,085	18,732,452	9,238,020
1907	55,697,949	16,727,928	16,783,943
1908	66,363,198	18,761,559	26,566,181
1909	82,972,209	20,237,870	32,398,187
1910	88,419,079	19,715,440	37,683,542
1911	87,497,879	19,738,908	40,552,088
1912	88,972,385	19,713,478	41,868,344
1913	98,644,639	20,406,958	48,578,014
1914	93,314,773	20,653,496	47,487,109
1915	96,663,369	22,442,296	43,503,837
1916	127,901,610	21,410,741	57,421,334
1917	161,202,962	20,087,504	86,976,209
1918	199,753,837	16,529,162	127,459,221
1919	195,830,002	16,695,955	142,610,563
1920	242,099,667	14,311,043	178,394,937
1921	268,157,472	15,704,822	203,138,225
1922	245,183,826	14,670,346	173,381,265
1923	344,024,678	13,379,013	242,731,309
1924	374,620,789	13,150,175	274,652,874
1925	434,519,660	13,065,330	330,609,829
1926	450,330,856	11,923,481	315,546,677
Totals	$4,355,246,332	$653,736,553	$2,559,294,605

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CHAPTER TWO.

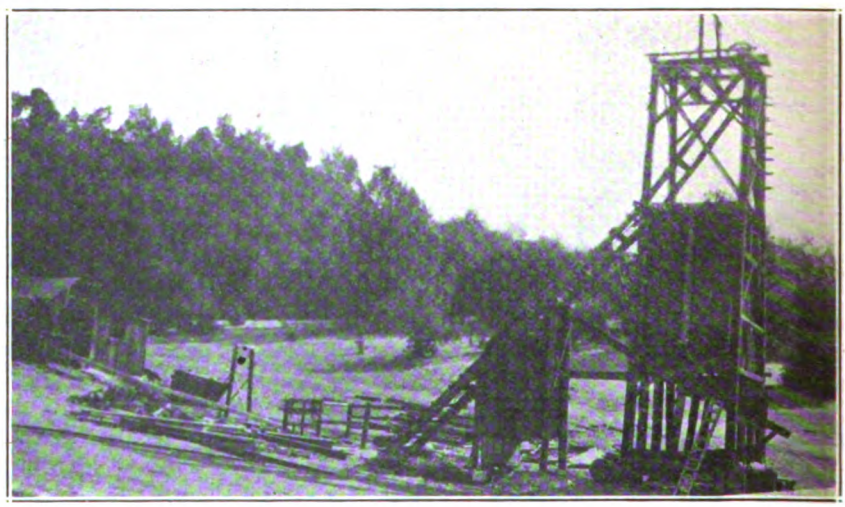
FUELS.

Among the most important mineral products of California are its fuels. This subdivision includes coal, natural gas, and petroleum, the combined values of which made up practically 81 per cent of the state's entire mineral output for the year 1926.

There are deposits of peat known in several localities in California, small amounts of which are used as a fertilizer, and in stock-food preparations, but none has yet been recorded as utilized for fuel.

Comparison of values during 1925 and 1926 is shown in the following table:

Substance	1925		1926		Increase + Decrease —
	Amount	Value	Amount	Value	Value
Coal	730 tons	$3,880	1,100 tons	$5,000	$1,120+
Natural gas	194,719,924 M cu.ft.	15,890,082	214,549,477 M cu.ft.	19,465,347	3,575,265+
Petroleum	232,492,147 bbls.	330,609,829	224,673,281 bbls.	345,546,677	14,936,848+
Total value		$346,503,791		$365,017,024	
Net increase					$18,513,233+



Buena Vista Coal Mine, near Ione, Amador County. Photo by C. A. Logan.

COAL.

Bibliography: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXI (inc.). U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rpt. 22, Pt. III.

Coal production in California in 1926 totaled 1100 short tons valued at $5,000, being credited to Amador, Shasta, and Siskiyou counties. Only a small part of it was marketed, as it was mainly consumed for local camp purposes and for power and forge use in development work on the deposits. Considerable development work is under way in Shasta County, as well as in Mendocino.

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Total Coal Production of California.

The very considerable output of coal in the years previous to 1883 was almost entirely from the Mount Diablo district, Contra Costa County. Later the Tesla mine in Corral Hollow, Alameda County, was an important producer for a few years. Stone Canyon, Monterey County, was also an important producer for a short time, and there has been some coal shipped from properties in Amador, Fresno, Orange, Riverside and Siskiyou counties. The following tabulation gives the annual tonnages and values, according to available records:

Coal Output and Value by Years.

Year	Tons	Value	Year	Tons	Value
1861	6,620	$38,065	1895	79,858	$193,790
1862	23,400	134,550	1896	70,649	161,335
1863	43,200	248,400	1897	87,449	196,255
1864	50,700	291,525	1898	143,045	337,475
1865	60,530	348,048	1899	160,941	420,109
1866	84,020	483,115	1900	176,956	535,531
1867	124,690	716,968	1901	150,724	401,772
1868	143,676	826,137	1902	88,460	248,622
1869	157,234	904,096	1903	93,026	265,383
1870	141,890	815,868	1904	79,062	376,494
1871	152,493	876,835	1905	46,500	144,500
1872	190,859	1,097,439	1906	24,850	61,600
1873	186,611	1,073,013	1907	23,734	55,849
1874	215,352	1,238,274	1908	18,496	55,503
1875	166,638	958,169	1909	49,389	216,913
1876	128,049	736,282	1910	11,033	23,484
1877	107,789	619,787	1911	11,047	18,297
1878	134,237	771,863	1912	14,484	39,092
1879	147,879	850,304	1913	25,198	85,809
1880	236,950	1,362,463	1914	11,859	28,806
1881	140,000	805,000	1915	10,299	26,662
1882	112,592	647,404	1916	4,037	7,030
1883	76,162	380,810	1917	3,527	7,691
1884	77,485	309,950	1918	6,343	16,149
1885	71,615	286,460	1919	2,983	8,203
1886	100,000	300,000	1920	2,078	5,450
1887	50,000	150,000	1921	12,467	63,578
1888	95,000	380,000	1922	27,020	135,100
1889	121,280	288,232	1923	1,010	5,090
1890	110,711	283,019	1924	1,425	8,800
1891	93,301	204,902	1925	730	3,880
1892	85,178	209,711	1926	1,100	5,000
1893	72,603	167,555			
1894	59,887	139,862	Totals	5,208,410	$23,103,358

The tonnages in the above table for the years 1861–1886 (incl.) are taken from the U. S. Geological Survey, "Mineral Resources of the U. S., 1910," p. 107. The values assigned for the years previous to 1883 are those given by W. A. Goodyear (Mineral Res., 1882, pp. 93–94), being an average of $5.75 per ton. From 1887 to date the figures are those of the California State Mining Bureau.

NATURAL GAS.

Bibliography: State Mineralogist Reports VII, X, XII, XIII, XIV. Bulletins 3, 16, 19, 69, 73, 89. Monthly Summary, Oil & Gas Supervisor, Dec. 1919; Aug., 1922; Mar., 1923; Mar. and Apr., 1926.

Statistics on the production of natural gas in California are in a considerable degree difficult to arrive at, as much of it that is utilized directly at the wells for heating, lighting, and driving gas engines is not measured. Hence, it is necessary to approximate the output of

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many of the operators in the oil fields, estimated on the number of lights, and on the number and horsepower of gas engines and steam boilers thus operated. The figures here given are for gas utilized locally and also that sold for distribution to consumers; and we consider are not over-estimated, particularly in the six oil-producing counties. It must be remembered that some of our important oil fields are removed many miles from the site of any other industry, and that the gathering of small amounts of gas and transporting it for any considerable distance may not always be profitable, nor is it often possible to have pipe-line facilities available to handle the gas accompanying the early gas production in newly developed fields. Wherever feasible, casing-head gas is used in driving gas engines for pumping and drilling, and in firing the boilers of steam-driven plants.

The most notable gas developments in California have been in the Elk Hills and Buena Vista Hills in Kern County, northeast of the Midway district; in the oil fields in the Los Angeles basin, Los Angeles and Orange counties; and more recently in Ventura County.

Production and Value.

There is rather a wide variation in prices quoted for natural gas because a considerable part is used directly in the field for driving gas engines and firing boilers, and is therefore not measured nor sold. Such companies as have placed a valuation on the gas that was thus used in 1926 gave from 3¢ to 25¢ per 1000 cu. ft., at the well. From the totals shown in the tabulation following herein, the average value for all fields in 1926 works out at approximately 9.1¢. Approximately 7000 cu. ft. of gas is equal to one barrel of oil in heating value, and is so accounted for by many operators. In driving gas engines, about 4000 cu. ft. per 24 hr. are consumed by a 25-h.p. engine, and 63,700 cu. ft. per day for heating a 70-h.p. steam boiler, which figures have been utilized in compiling this report, in those cases where gas was not metered.

Natural Gas 'Consumed,' or Utilized for Fuel, 1926.

County	*M cu. ft.*	*Value*
Fresno	1,920,489	$153,726
Kern	44,182,140	2,158,867
Kings	470	245
Los Angeles	91,054,793	8,965,307
Orange	33,276,379	3,556,194
Santa Barbara	2,230,501	246,091
Ventura	41,559,144	4,080,040
Butte, Humboldt, Lake, Mendocino, Sacramento, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Sutter, Tulare, Yuba*	325,561	304,877
Totals	214,549,477	$19,465,347

* Combined to conceal output of a single operator in each.

The above totals for 1926 compare with 194,719,924 M cu. ft., valued at $15,890,082 in 1925. Important increases in quantity in 1926 were made by Ventura County, which shows 41,559,144 M cu. ft., worth $4,080,040, as against 20,144,646 M cu. ft. and $1,953,163 in 1925; and Orange County with 33,276,379 M cu. ft., worth $3,556,194, against 26,324,369 M cu. ft and $2,324,014 in 1925. Fresno County showed a slight increase, Los Angeles and Kern counties utilized somewhat

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smaller quantities of natural gas; but, there was a larger recovery of natural-gas gasoline from the gas treated.

Natural Gas Production in California, Since 1888.

The production of natural gas in California by years since 1888 is given in the following table. The first economic use of natural gas in California was from the famous Court House well at Stockton, bored in 1854–1858. Beginning about 1883 and for several succeeding years, a number of gas wells were brought in around Stockton. Natural gas was known in a number of other localities, and occasionally utilized in a small way, notably at Kelseyville in Lake County, and in Humboldt County near Petrolia and Eureka, but there are no available authentic records of amounts or values previous to the year 1888. The most important developments in the commercial production of natural gas have been coincident with developments in the oil fields, by utilizing the casing-head gas as well as that from dry-gas wells.

Year	M cubic feet	Value	Year	M cubic feet	Value
1888	[a]12,000	$10,000	1908	842,883	$474,584
1889	[a]14,500	12,680	1909	1,148,467	616,932
1890	[a]41,250	33,000	1910	10,579,933	1,676,367
1891	[a]39,000	30,000	1911	[a]5,000,000	491,859
1892	[a]75,000	55,000	1912	[a]12,600,000	940,076
1893	[a]84,000	68,500	1913	14,210,836	1,053,292
1894	[a][b]85,080	79,072	1914	16,529,963	1,049,470
1895	[a][b]110,800	112,000	1915	21,992,892	1,706,480
1896	[a][b]131,100	111,457	1916	28,134,365	2,871,751
1897	[a]71,300	62,657	1917	44,343,020	2,964,922
1898	[a]111,165	74,424	1918	46,373,052	3,289,524
1899	115,110	95,000	1919	52,173,503	4,041,217
1900	40,566	34,578	1920	58,567,772	3,898,286
1901	120,800	92,034	1921	67,043,797	4,704,678
1902	120,968	99,443	1922	103,628,027	6,990,030
1903	120,134	75,237	1923	240,405,397	15,661,433
1904	144,437	91,035	1924	209,021,596	15,153,140
1905	148,345	102,479	1925	194,719,924	15,890,082
1906	168,175	109,489	1926	214,549,477	19,465,347
1907	169,991	114,759			
			Totals	1,344,688,625	$104,402,314

[a] Quantity, in part, estimated, where values only were reported.
[b] Includes natural CO_2 from a mine in Santa Clara County.

Gasoline from Natural Gas.

More or less gas usually accompanies the petroleum in the oil fields, and such gas carries varying amounts of gasoline. A total of 148 plants were in operation in 1926 recovering gasoline by compression or absorption from this 'casing-head' gas. After the gasoline is extracted the remaining 'dry gas' so far as practicable is taken into pipe lines, by which it is distributed to consumers, both domestic and commercial.

In certain of the oil fields, some of the casing-head gasoline is obtained as an incidental product to the compressing of the natural gas preliminary to its transmission to consuming centers through the gas pipe lines. Some concerns market the casing-head gasoline separately, others blend it with distillery gasoline, while others turn it into the oil pipe lines thus mixing this high-gravity gasoline with the crude oil for transportation to the refinery where it is later regained. A total of 389,026,757 gallons of casing-head gasoline valued at $51,788,346 from all fields was reported as made by 148 plants during 1926, compared with 301,-

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755,000 gallons valued at $39,288,500 by 83 operators and 163 plants in 1925. It was distributed by counties, as follows:

Natural-Gas Gasoline Recovered, 1926.

County	*No. plants*	*Gallons*	*Value*
Fresno	1	767,914	$92,152
Kern	38	75,816,000	10,310,976
Los Angeles	72	224,413,000	29,622,516
Orange	25	59,998,671	7,919,825
Santa Barbara	3	6,230,798	856,226
Ventura	9	21,800,374	2,986,651
Totals	148	389,026,757	$51,788,346

The usual recoveries of gasoline from natural gas vary from ½ gal. to 3 gal. per 1000 cu. ft. of gas handled, the average being about 1 gal. per 1000 cu. ft. The U. S. Bureau of Mines report by Knudsen & Mashaw[1] gives the average recovery for 1926 as 1.369 gallons per 1000 cu. ft. of gas treated. Their figures show the following production, by methods:

Natural-Gas Gasoline Production, 1926, by Methods.

(Per U. S. Bureau of Mines)

Method	*Gallons*	*Recovery (Gal. per M. cu. ft.)*
Oil absorption	183,472,906	1.421
Compressor	5,801,139	1.464
Combination compressor and oil absorption	142,027,856	1.479
Combination oil and charcoal absorption	56,094,597	1.378
Charcoal absorption	1,796,013	0.124
Drip	173,826	----
Totals	389,366,337	1.369

PETROLEUM.

Bibliography: State Mineralogist Reports IV, VII, X, XII, XIII. Bulletins 3, 11, 16, 19, 31, 32, 63, 69, 73, 82, 84, 89. Reports of Oil and Gas Supervisor 1915 to date (issued in monthly chapters since April, 1919). U. S. Geol. Surv., Bulletins 213, 285, 309, 317, 321, 322, 340, 357, 398, 406, 431, 471, 541, 581, 603, 621, 623, 653, 691; Prof. Papers 116, 117. "American Petroleum; Supply and Demand"; Amer. Petr. Inst., 1925.

The crude oil production of California for 1926 amounted to a total of 224,673,281 barrels of clean oil, valued at $345,546,677 at the well. This total of quantity is compiled from the monthly production reports filed by the operators with the State Oil and Gas Supervisor, to which have been added figures for the output of a number of small operators in the old Los Angeles City field not under the jurisdiction of the Supervisor, and a small production in San Mateo County which was also not reported to that office.

The question of the value of the crude oil yield at the well is a difficult one to settle with exactitude, principally because a large part of the output is not sold until after refining. The large refiners are also large producers of crude oil which they send direct from well to plant, hence much of the crude oil is not sold as such. The values used in the statistical reports of the State Mining Bureau since 1914 have been derived from averages of actual sales of crude oil of all grades in each

[1] Knudsen, E. T., and Mashaw, J. W., Statistical summary of California petroleum industry, 1926: U. S. Bureau of Mines, 1927, pp. 46, 47.

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field of the state, and these averages applied to the total yield of the respective fields. This we feel is a safer measure of commercial values than market quotations, because quotations do not always mean sales. This is particularly true on a rising or a falling market.

Features of 1926.

The noteworthy features of the year 1926 in the oil industry of California were the higher prices prevailing and the decreased output in all fields except Ventura which increased 7,800,000 barrels during the year. The principal decrease was in the Inglewood and Long Beach fields of Los Angeles County.

Summarizing the data for the year, the State Oil and Gas Supervisor[1] presented the following figures:

"The total production of the state for the last six months of 1926 was 114,502,082 barrels of oil and 55,815,808 barrels of water. The production of oil for the year 1926 was, therefore, 224,523,424 barrels, a decrease of 7,810,814 barrels from 1925. A decrease is shown in all districts except No. 2 where the Ventura field increased over 7,800,000 barrels during 1926. The principal decrease was in District No. 1 in the Inglewood and Long Beach fields.

"The production of oil for the second half of 1926 was 4,480,740 barrels more than for the first half. Water production increased 3,728,579 barrels during the same period. * * *

"The estimated closed-in production remained fairly constant during the year, declining from 60,216 barrels daily during January to 51,619 barrels daily during June and increasing to 54,959 barrels daily during December. * * *

Storage and Price Changes.

"The total crude and refined petroleum in storage in Pacific Coast territory at the end of 1926 was 145,612,176 barrels according to the American Petroleum Institute. The decrease in storage during the year amounted to 11,704,133 barrels compared with an increase of 32,294,345 (revised) barrels during 1925. Of the storage decrease during 1926, 8,214,864 barrels were destroyed by fire. The total amount of crude and refined oil shipped to eastern ports during 1926 was 33,038,000 barrels, or 5,101,000 barrels more than the 1925 shipments.

"Prices of the lighter grades of crude oil were higher during most of 1926 than in 1925. On March 11, 1926, the price of oil above 18 degrees gravity was advanced in most fields, while the lower grades remained unchanged.

Drilling and Development.

"During 1926, 1268 wells were reported to the State Oil and Gas Supervisor as ready to drill as compared with 1359 new wells in 1925. Of the total number 107, or 8 per cent, were wildcat wells.

"The outstanding developments were the discovery of the Seal Beach field by Mariand Oil Company of California, discovery of the Mt. Poso field in Kern County by Shell Company of California, discovery of a small amount of oil at comparatively shallow depth in the 'Middle Dome' of the Kettleman Hills structure in Kings County by Bolsa Chica Oil Company, and discovery of very light oil at shallow depth near Goleta, Santa Barbara County, by Miley Oil Company. The Long Beach field was considerably extended to the northwest in the Los Cerritos area, the Huntington Beach field into part of the townsite area, and the Ventura field was extended on all sides and production very materially increased by deeper drilling in the central portion of the field."

Outlook for 1927.

Figures for the first six months of 1927 indicate an increase in yield for the current year compared with 1926, being 2,000,000 barrels more than the last six months of 1926. The daily average production was 639,381 barrels in June compared with 610,000 barrels in June, 1926, and 651,125 barrels in January, 1927. Effective April 1, 1927, there was a marked cut in prices posted for the higher grades of crude oil, amounting to as much as 50% in some fields.

[1] Bush, R. D., Resumé of oil field operations of California in 1926; Cal. State Min. Bur., 12th Ann. Rep. of State O. & G. Super., No. 8, Feb. 1927, pp. 5 and 6.

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Production Figures.

The following table gives the production and value by counties for 1926 compared with the 1925 figures:

TABLE A.

Production and Value of Crude Oil, by Counties.

County.	1925 Barrels.	1925 Value.	1926 Barrels.	1926 Value.
Fresno	7,773,665	$8,503,390	7,340,102	$5,982,183
Kern	58,852,742	84,255,094	54,549,646	78,987,887
Los Angeles	121,214,551	173,215,593	105,826,337	174,084,324
Orange	32,734,420	46,384,673	37,989,349	59,225,395
San Luis Obispo	29,590	32,164	27,982	22,162
Santa Barbara	2,647,380	2,419,705	1,925,204	1,526,587
Santa Clara	13,828	22,594	[b]	[b]
Ventura	9,221,846	15,769,357	16,994,275	25,695,344
San Bernardino and San Mateo	[a] 4,125	7,259	----------	----------
Kings, San Bernardino, San Mateo, Santa Clara, Sonoma [b]	----------	----------	[b] 20,386	22,795
Totals	232,492,147	$330,609,829	224,673,281	$345,546,677

[a] Combined to conceal output of a single operator in San Bernardino County.
[b] Combined to conceal output of a single operator in each.

The foregoing totals show a state average price of $1.538 per barrel for the year 1926, as compared to $1.422 in 1925 and $1.200 in 1924.

TABLE B.

Average Price of Oil per Barrel, by Counties, 1917-1926.

County	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926
Fresno	$0.516	$0 825	$1.191	$1 293	$1 483	$1.068	$1 710	$1.162	$1.094	$0 815
Kern	.641	.893	1 252	1 350	1 714	1 211	.819	1.137	1.432	1 448
Los Angeles	.651	1 176	1 340	1 380	1 532	1.403	.971	1 239	1.429	1 615
Orange	.663	1.003	1.412	1 860	2 138	1.175	.880	1 183	1 417	1.559
San Luis Obispo	.450	.926	.905	1.040	1 400	.942	.600	.992	1 087	----
Santa Barbara	.794	.808	1 235	1.125	1 575	1 011	.782	1.036	.914	.793
Santa Clara	.666	1 387	1.700	1.600	1 485	1 616	1 401	1 921	1 634	----
Ventura	1.045	1 318	1 480	1.635	2 507	1 785	1.138	1.334	1 710	1 512
State average	$0 636	$0 908	$1 278	$1 409	$1.726	$1 249	$0 923	$1 200	$1 422	$1 538

For several years previous to 1919, the state average value per barrel at the well for crude oil as determined by the statistical returns was noted to practically coincide with the quotations during the same years for 23° gravity oil in the San Joaquin Valley fields. In 1919 and since, the average values have worked out at figures corresponding to quotations up to, in one year as high as 28° oil, due to the large yield of high-gravity oils from the new fields in the Los Angeles-Orange counties area.

TOTAL PETROLEUM PRODUCTION OF CALIFORNIA.

The presence of oil seepages and springs in Los Angeles and Ventura counties was known and utilized in a small way early in the history of California. Some also was shipped to refineries at San Francisco from Santa Barbara and Humboldt counties. In the light of present-day developments, the following reference to the previous year's production of oil and its future prospects as expressed by the San Francisco Bulletin of January 8, 1866, is strikingly prophetic even though skeptical:

"It is possible that the small quantity received (40,000 or 50,000 gallons in 1865) may be the forerunner of many millions which will, at some future time, lubricate

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the wheels of commerce and set a trade at work excelling in variety any that has thus far been known on this coast. At present, however, we admit to being a little skeptical about the assumption of the astute Professor Silliman that California will be found to have more oil in its soil than all the whales in the Pacific Ocean."

According to Hanks,[1] in 1874 production amounted to 36 bbl. per day from natural flows in Pico Cañon (Newhall), and at Sulphur Mountain (Ventura County), the oil being of 32° gravity average.

[2] "Work was commenced in Pico Canyon in 1875 by drilling three shallow wells with spring pole, all of which yielded oil at depths of from 90 to 250 feet. Actual work of development commenced with steam machinery in 1877."

In 1877 Pico averaged 40–50 bbl. daily, and Ventura 80 bbl. daily. In 1878, there was some production (@ 60 bbl. per day, for a time) from wells in Moody Gulch, near Los Gatos, Santa Clara County, the oil being of 46° Baumé.

The first wells in the Coalinga, Fresno County, and Summerland, Santa Barbara County, fields were drilled in 1890, but Coalinga did not make its influence felt conspicuously on the state's annual output until 1903. The Summerland yield never has been large. The Salt Lake field near Los Angeles began production in 1894 and in 1897 reached over a million barrels annually.

In the Kern County fields, the first well was drilled in Sunset in 1891, Midway in 1900, McKittrick in 1892, Kern River in 1899. The Sunset-Midway district attained a yield of over 4,000,000 bbl. in 1909, and over 20,000,000 bbl. in 1910. Kern River field produced over 3,000,000 bbl. in 1901.

The first well in the Santa Maria-Lompoc group, Santa Barbara County, was drilled in 1901, and the district advanced to a yield of over 3,000,000 bbl. annually in 1905.

The Whittier-Fullerton field in Los Angeles and Orange counties became an important factor in 1902. The Montebello field, Los Angeles County, was the conspicuous addition in 1918-1919; and Elk Hills, Kern County, with Huntington Beach and Richfield, Orange County, in 1920. In 1921, the new fields added were Long Beach and Santa Fe Springs, Los Angeles County; in 1922, Torrance field in Los Angeles County, and Wheeler Ridge field in Kern County; but the production from the large number of new wells started in these new Los Angeles County fields did not reach its peak until August and September, 1923. Dominguez (Compton) came in during 1923; followed by Rosecrans and Inglewood in 1924. Ventura recorded important additions to its producing area in 1925 and 1926. Seal Beach, Orange County, and Mt. Poso, Kern County, were the new fields added in 1926.

The effect of the advent of these various fields to the producing column will be noted in the tabulation herewith, by years:

[1] Hanks, Henry G., Report IV of State Mineralogist, p. 298, 1884.
[2] *Idem*, p. 301.

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TABLE C.

Total Petroleum Production in California.

Year	Barrels	Value	Year	Barrels	Value
To and inc. 1875	(a) 175,000	(b) $472,500	1902	14,356,910	$4,692,189
1876	12,000	30,000	1903	24,340,839	7,313,271
1877	13,000	29,250	1904	29,736,003	8,317,809
1878	15,227	30,454	1905	34,275,701	9,007,820
1879	19,858	39,716	1906	32,624,000	9,238,020
1880	40,552	60,828	1907	40 311,171	16,783,943
1881	99,862	124,828	1908	48,306,910	26,566,181
1882	128,636	257,272	1909	58,191,723	32,398,187
1883	142,857	285,714	1910	77,697,568	37,689,542
1884	262,000	655,000	1911	84,648,157	40,552,088
1885	325,000	750,750	1912	89,689,250	41,868,344
1886	(a) 377,145	(b) 870,205	1913	98,494,532	48,578,014
1887	678,572	1,357,144	1914	102,881,907	47,487,109
1888	690,333	1,380,666	1915	91,146,620	43,503,837
1889	303,220	368,048	1916	90,262,557	57,421,334
1890	307,360	384,200	1917	95,396,309	86,976,209
1891	323,600	401,264	1918	99,731,177	127,459,221
1892	385,049	561,333	1919	101,182,962	142,610,563
1893	470,179	608,092	1920	103,377,361	178,394,937
1894	783,078	1,064,521	1921	112,599,860	203,138,225
1895	1,245,339	1,000,235	1922	138,468,222	173,381,265
1896	1,257,780	1,180,793	1923	262,875,690	242,731,309
1897	1,911,569	1,918,269	1924	228,933,471	274,652,874
1898	2,249,088	2,376,420	1925	232,492,147	330,609,829
1899	2,677,875	2,660,793	1926	224,673,281	345,546,677
1900	4,329,950	4,152,928			
1901	7,710,315	2,961,102	Totals	2,544,628,772	$2,562,901,128

[a] U. S. G. S., Min. Res. of U. S., 1886, p. 440, for quantities to and including 1886.
[b] Values have been estimated for the years to and including 1886, after consulting a number of contemporaneous publications, including the Mining & Scientific Press, Reports of the State Mineralogist, and U. S. Reports. The figures for 1887 to date are from records of the State Mining Bureau.

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Well Data.

The following table is compiled from the monthly statements issued by the American Petroleum Institute:

TABLE D.

Wells Operated by Fields, 1926.

Field	Wells producing Dec., 1925	Wells producing Dec., 1926	Wells completed during year	Daily initial output	Wells abandoned during year	Barrels per well produced per day Dec., 1925	Barrels per well produced per day Dec., 1926
Kern River	1,599	1,339	31	5,170	15	7.4	9.2
McKittrick	302	310	9	225	8	18.4	17.3
Midway-Sunset	2,906	2,985	161	21,704	30	31.8	30.2
Elk Hills	240	245	14	4,053	11	3,769.3	141.3
Lost Hills-Belridge	291	312	5	157	2	14.5	15.7
Coalinga	929	954	20	843	12	20.1	20.3
Wheeler Ridge	22	28	6	693		45.7	35.2
Watsonville	6	6				9.5	9.7
Santa Maria-Lompoc	251	215	3	535	37	22.4	22.3
Summerland	135	135				0.9	1.0
Ventura Ave		76	32	86,874	1		695.8
Ventura-Newhall	591	521	12	1,475	23	62.2	117.5
Los Angeles-Salt Lake	387	371			11	5.0	5.0
Whittier	189	185	5	220	3	10.6	10.4
Fullerton	401	444	19	16,423	11	34.8	60.3
Coyote	209	211	2	348	4	81.5	74.4
Santa Fe Springs	350	351	12	2,463	18	142.7	123.7
Montebello	163	186	26	4,380	6	110.4	93.6
Richfield	185	198	20	9,803	6	72.2	94.7
Huntington Beach	335	449	126	112,159	19	138.3	21.0
Long Beach	620	711	259	62,996	103	175.8	132.7
Torrance (Redondo)	603	661	52	7,471	29	52.3	39.8
Dominguez (Compton)	62	75	11	4,536		402.4	262.1
Rosecrans	113	137	33	18,527	29	217.5	91.4
Inglewood	171	212	43	19,861	15	368.0	186.6
Seal Beach		5	5	10,549	2		14.0
Newport	9	11	7	155	1	8.1	86.4
Miscellaneous drilling					86		
Totals	11,069	11,333	913	391,620	482	[a]56.1	[a]57.7

[a]State average.

"WILDCAT WELLS ABANDONED IN 1925 AND 1926.[1]

"In California during 1925 and 1926, 391 wildcat wells were drilled, and all but two were abandoned as unsuccessful, as shown by the records of the Department of Petroleum and Gas. Most of these wells were drilled to discover new fields, but many were drilled near the edges of producing fields in an effort to extend the proved area. Many other wells were drilled and abandoned which are not included in this number as they were not drilled for the purpose of discovering or producing oil. Some were small diameter holes drilled on United States Government land, usually to a depth of about 500 feet, merely to comply with prospecting permit requirements, and the others were drilled by some of the large companies for the purpose of obtaining geologic information as to subsurface structure and geologic age of the formations in areas where little can be determined from surface evidence. Many of these wells were 2000 feet and more in depth.

"Wildcat drilling during the two years resulted in the discovery of two fields, Seal Beach and Mt. Poso, by Marland Oil Company of California and Shell Company of California, respectively. Small quantities of oil were discovered in wildcat wells in other areas, but the significance and commercial value of these discoveries had not been determined by the end of 1926.

"A list of 1070 wells abandoned during the eleven-year period 1914 to 1924, inclusive, was given in 'Summary of Operations—California Oil Fields, Vol. 11, No. 1, and in Table III it was shown that the average depth drilled was 2773 feet. The average depth drilled in 252 wells by nine large companies was 3759 feet resulting in the discovery of 13 of the 15 new fields discovered in the eleven-year period.

"Table I, given below, shows the number of wildcat wells drilled, total and average depths, and fields discovered by ten large companies and all others during 1925 and 1926. That it is becoming increasingly difficult to discover new fields in California and that greater depths of drilling, consequently greater costs, are necessary is evident from a comparison with the table referred to above. Two fields were discovered in drilling and abandoning 391 wells, or two fields in drilling and abandoning 122 wells by ten large companies which drilled 5 or more wells in the two-year period. The average depth of the 391 wells was 3642 feet; and of 122 wells drilled by the ten companies was 4566 feet. Of the 391 wells listed in Table I, one was 7221 feet deep, 21 were over 6000 feet deep, and 71 were over 5000 feet deep."

[1] Bush, R. D., Summary of Operations, California Oil Fields: Cal. State Min. Bur., Twelfth Rep. of State Oil and Gas Supervisor, No. 8, Feb., 1927, pp. 49-50.

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"TABLE I.

Number of Wildcat Wells Abandoned, Depths, and Fields Discovered by Ten Companies.

Company	Total wells	Number new fields	Total depths (feet)	Average depth per well (feet)
Associated Oil Company	7	0	38,083	5,440
California Petroleum Corporation[1]	7	0	31,058	4,437
General Petroleum Corporation	9	0	32,155	3,573
Marland Oil Company of California	10	1	46,736	4,674
Milham Exploration Company	9	0	29,173	3,241
Pan American Petroleum Company	5	0	24,461	4,892
Shell Company of California	17	1	86,572	5,092
Standard Oil Company of California	29	0	136,634	4,711
Superior Oil Company	10	0	42,712	4,271
Union Oil Company of California	19	0	89,494	4,710
Totals	122	2	557,078	4,566
All others	269	0	866,992	3,223
Grand totals	391	2	1,424,070	3,642

[1] Includes Petroleum Midway Company, Ltd."

Specific Gravity of Oils Produced.

The proportion of heavy and light oil produced in the various fields is shown in Table E, following, for which we are indebted to the Standard Oil Company. Under present practice, oil below 18° Baumé may be considered as largely refinable for fuel oil and lubricants, while the lighter oils yield varying amounts of the higher refined products with corresponding proportions of residuum and fuel oil. Specific gravities in California range from 8° Baumé in the Casmalia field, Santa Barbara County, to 56° Baumé in Ventura County.

California crude oils are all essentially of asphalt base, with a few notable exceptions. In the following localities are wells yielding crudes containing both asphalt and paraffine constituents: Oil City field, Coalinga; a few deep wells in East Side field, Coalinga; a considerable part of the Ventura County fields; Western Minerals area, south of Maricopa; Wheeler Ridge, Kern County.

TABLE E.

Production of Light and Heavy Oil, by Fields, 1926.

Field	*Under 18° (barrels)*	*18° and over (barrels)*	*Total (barrels)*
Kern River	4,410,705	----------	4,410,705
Lost Hills-Belridge	361,325	1,346,018	1,707,343
McKittrick	1,983,433	----------	1,983,433
Midway-Sunset	10,287,459	23,845,989	34,133,448
Elk Hills	918,477	11,404,804	12,323,281
Coalinga	3,959,261	3,424,409	7,383,670
Wheeler Ridge	----------	372,202	372,202
Watsonville	23,725	----------	23,725
Santa Maria	839,736	1,016,163	1,855,899
Summerland	38,715	----------	38,715
Ventura-Newhall	59,313	2,165,043	2,224,356
Ventura Avenue	----------	14,787,355	14,787,355
Los Angeles-Salt Lake	657,002	2,301	659,303
Whittier-Fullerton	894,536	24,939,916	25,834,452
Santa Fe Springs	----------	17,529,016	17,529,016
Huntington Beach	407,168	18,648,774	19,055,942
Long Beach	225,382	37,658,367	37,883,749
Torrance	3,995,809	6,365,245	10,361,054
Dominguez	----------	7,804,221	7,804,221
Rosecrans	----------	6,097,299	6,097,299
Inglewood	1,720,920	15,673,524	17,394,444
Seal Beach	----------	588,657	588,657
Miscellaneous	33,399	6,736	40,135
Totals	30,816,365	193,676,039	224,492,404

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As previously noted by the writer,[1] a decided change has taken place in the relative proportions of light and heavy crudes produced in California since 1910, taking 18° Baumé as the dividing line. This subject has also been covered in detail and with charts, by Collom and Barnes.[2]

A marked drop took place in the low-gravity yield from 1910 to and including 1914. From 1914, it remained almost stationary, with a slight drop in 1921, while the high-gravity yield has increased at a rapid rate since 1915. The proportions have been reversed from approximately 75% low—25% high in 1914 to 25% low—75% high in 1921; 10% low—90% high in 1923; and 14% low—86% high in 1924–1926.

This has been an important factor in its effect upon the average price per barrel of the state's output in these years, as well as its effect upon the relative situation between production and consumption. It has been a fortunate development, in view of the increased demand for refinery products (gasoline in particular).

Oil in 'Storage.'

Field, refinery, pipe-line, and tank-farm stocks of crude and refinery products in Pacific Coast territory totaled 145,612,176 barrels,[3] December 31, 1926, compared with 157,316,309 barrels on December 31, 1925. Of the 11,704,133 barrels decrease during the year, 8,214,864 barrels of tank-farm oils were destroyed by fire.

Stocks	*Dec. 31, 1926 (barrels)*	*Dec. 31, 1925 (barrels) (revised)*
Heavy crude, heavier than 20° A. P. I., including all grades of fuel	88,707,499	86,519,383
Refinable crude, 20° A. P. I., and lighter	30,835,057	44,196,138
Gasoline	11,673,563	10,172,562
Naphtha distillates	3,832,042	6,548,483
All other stocks	10,564,015	9,879,743
Totals, all stocks	145,612,176	157,316,309

Operating Data.

The following tabulation (Table F) is compiled from data published by the Department of Petroleum and Gas,[4] semiannually, and here combined to show the entire year's operations for all fields. The districts are the geographical subdivisions as administered by the Department, and which are outlined on the accompanying map.

It will be noted that the state average yield of oil per well per day was 60.1 barrels for the first six months of 1926 and 60.9 barrels for the second. This is somewhat higher than the figure of 57.7 barrels average for December derived from American Petroleum Institute data as shown in Table D, on a preceding page, due in part at least, to the fact that the latter is on a full-time basis, whereas the Bureau figures allow for shut-down time.

[1] Bradley, W. W., Mineral production of California in 1921: Cal. State Min. Bur., Report XVIII, p. 442. Sept., 1922.
[2] Collom, R. E., and Barnes, R. M., California oil production and reserves: Cal. State Min. Bur., Ninth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1923, pp. 5-23.
[3] Standard Oil Bulletin, February, 1927, p. 15.
[4] Summary of operations, California Oil Fields: Cal. State Min. Bur., Twelfth Ann. Rep. of State Oil and Gas Supervisor, Aug., 1926, pp. 6-7; Feb., 1927, pp. 8-9.

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TABLE F. Production Statistics and Operating Data of California Oil Fields—1926.

Field	January 1 to June 30						July 1 to December 31					
	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced	Average number of producing wells—actual	Oil (bbl.)	Number of days producing	Production per well per day (bbl.)		Percentage of time wells produced
				Oil	Water					Oil	Water	
District No. 1:												
Beverly Hills	15	70,279	2,550	27.6	39.3	93.9	15	76,270	2,532	30.1	33.5	91.7
Brea Olinda	408	3,045,448	64,042	47.6	16.5	86.7	425	4,016,252	71,794	55.9	14.7	91.8
Coyote Hills	207	[a]3,069,573	36,768	83.5	34.9	98.1	204	2,956,893	36,679	80.6	35.4	97.5
Dominguez	67	3,911,2 0	11,593	237.4	36.8	95.6	75	3,927,927	13,175	298.1	45.4	96.0
Huntington Beach	362	[a]8,168,887	60,011	136.1	31.9	91.5	407	[b]11,074,825	67,317	164.6	33.3	89.9
Inglewood	193	9,722,917	32,618	298.1	26.5	93.5	204	[b]7,921,104	35,704	221.9	24.9	95.1
Long Beach	730	[a]19,624,052	118,208	166.0	53.9	89.5	749	[b]17,955,897	126,205	142.3	57.9	90.2
Montebello	178	3,293,288	30,436	108.2	67.0	94.7	192	3,306,294	33,944	97.4	65.7	96.2
Newhall	76	34,316	13,370	2.6	4.0	97.8	77	[b]35,372	13,757	2.6	4.3	97.5
Newport	10	17,080	1,329	12.9	10.7	71.3	12	[b]15,617	1,749	8.9	7.9	76.0
Richfield	177	2,382,556	29,749	80.1	5.2	93.0	188	[b]3,240,458	32,136	100.8	7.3	92.9
Rosecrans	122	[a]3,507,322	19,436	180.5	46.8	88.2	133	[b]2,560,649	22,509	113.8	50.1	91.9
Salt Lake	82	175,756	14,157	12.4	19.1	95.6	82	177,111	14,499	12.2	[c]5.4	96.3
Santa Fe Springs	358	9,059,025	60,250	150.4	60.9	92.9	356	8,669,116	61,072	141.9	66.4	93.2
Seal Beach							3	587,448	297	1,977.9	33.2	76.7
Torrance	640	[a]5,310,498	104,363	50.9	2.9	90.0	670	4,982,824	113,609	43.9	3.3	92.2
Whittier	172	385,826	27,737	13.9	23.4	88.8	175	373,926	27,887	13.4	25.1	86.9
Totals	3,797	71,778,143	626,617	114.5	32.0	91.2	3,967	71,882,983	674,865	106.5	33.3	92.5
District No. 2:												
Bardsdale	149	170,015	25,850	6.6	1.0	95.9	150	168,114	24,535	6.9	1.1	88.9
Conejo	34	1,391	5,786	0.2	0.1	94.0	1	220	55	3.6	0.3	29.9
Ojai	70	35,061	11,514	3.0	1.8	90.9	74	33,213	12,265	2.7	1.9	90.1
Piru	94	81,956	15,466	5.3	12.3	90.9	93	90,982	13,120	6.9	10.2	76.7
Santa Paula	23	10,147	3,525	2.9	0.6	84.7	22	10,429	3,958	2.6	0.5	97.8
Sespe	24	24,352	3,964	6.1	0.1	91.3	28	22,997	3,863	6.0	0.05	75.0
Simi	51	26,070	8,032	3.2	1.3	87.0	49	24,762	8,028	3.1	1.2	89.0
South Mountain	62	700,487	10,745	65.2	0.3	95.7	69	722,374	11,692	61.8	0.2	92.1
Ventura	71	5,684,223	10,039	566.2	49.6	78.1	83	9,187,502	13,309	678.2	41.0	87.5
Totals	578	6,733,702	94,921	70.9	7.9	90.7	569	10,260,573	90,885	112.9	8.2	86.8

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District No. 3:												
Arroyo Grande	19	12,975	2,886	4.5	4.8	83.9	19	15,007	3,035	4.9	5.0	86.8
Casmalia	26	32,356	3,935	8.2	139.0	83.6	12	20,367	2,206	9.2	41.6	99.1
Cat Canyon	36	374,021	5,726	66.2	8.3	87.9	37	390,380	5,904	66.1	8.4	86.7
*Half Moon Bay	4	388	362	1.1	0.3	50.0	4	388	368	1.1	0.3	50.0
Lompoc	1	16,457	164	100.3	1.1	90.6	0	0	0	0	0	0
Moody Gulch	0	0	0				0	0	0	0	0	0
Santa Maria	157	543,931	21,975	24.8	39.7	77.3	156	519,964	22,036	23.6	41.0	76.8
Sargent	9	6,315	1,629	3.9	.0	100.0	9	6,270	1,656	3.8	0.0	100.0
*Summerland	91	16,458	15,147	1.1	12.9	92.0	91	16,786	15,420	1.1	12.9	92.1
Totals	343	1,007,901	51,824	19.4	32.3	83.5	328	969,162	50,625	19.1	24.9	83.9
District No. 4:												
Belridge-Lost Hills-Devils Den	269	808,090	44,461	18.2	38.7	91.3	278	870,037	46,974	18.5	31.6	91.8
Elk Hills	249	5,850,940	41,348	141.5	11.5	91.7	255	6,291,218	43,233	145.5	13.0	92.1
Kern River	1,590	2,056,614	272,402	7.5	46.8	94.7	1,418	2,169,833	247,816	8.8	59.4	95.0
McKittrick-Temblor	304	1,013,965	52,343	19.4	80.1	95.1	302	993,144	52,965	18.8	82.6	95.3
Midway-Sunset	2,844	16,908,188	478,585	35.3	17.8	93.0	2,921	17,161,821	499,483	34.4	16.3	92.9
Mount Poso							3	52,124	215	242.4	2.0	38.9
Wheeler Ridge	23	178,405	4,082	43.7	5.7	98.1	27	195,247	4,715	41.4	4.3	94.9
Totals	5,279	26,816,202	893,221	30.0	31.0	93.5	5,204	27,733,424	895,401	30.9	32.7	93.5
District No. 5:												
Coalinga	970	3,685,394	163,454	22.6	11.6	93.1	972	3,654,708	169,229	21.6	12.0	94.6
Petaluma							1	1,232	180	6.8	0.0	97.8
Totals	970	3,685,394	163,454	22.6	11.6	93.1	973	3,655,940	169,409	21.6	12.0	94.6
Grand totals	10,967	110,021,342	1,830,037	60.1	28.5	92.2	11,041	114,502,082	1,881,185	60.9	29.7	92.6

[a] The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Coyote Hills	1	1,763	174
Huntington Beach	1	3,920	112
Long Beach	22	334,732	2,923
Rosecrans	1	8,150	150
Torrance	4	15,665	633

[b] The exact production for some wells could not be obtained and the following estimates were incorporated in the above figures:

Huntington Beach	3	33,258	357
Inglewood	1	8,593	115
Long Beach	18	215,301	2,590
Newhall	2	1,342	224
Newport	1	2,100	90
Richfield	1	1,640	72
Rosecrans	2	5,243	287

*Estimated.

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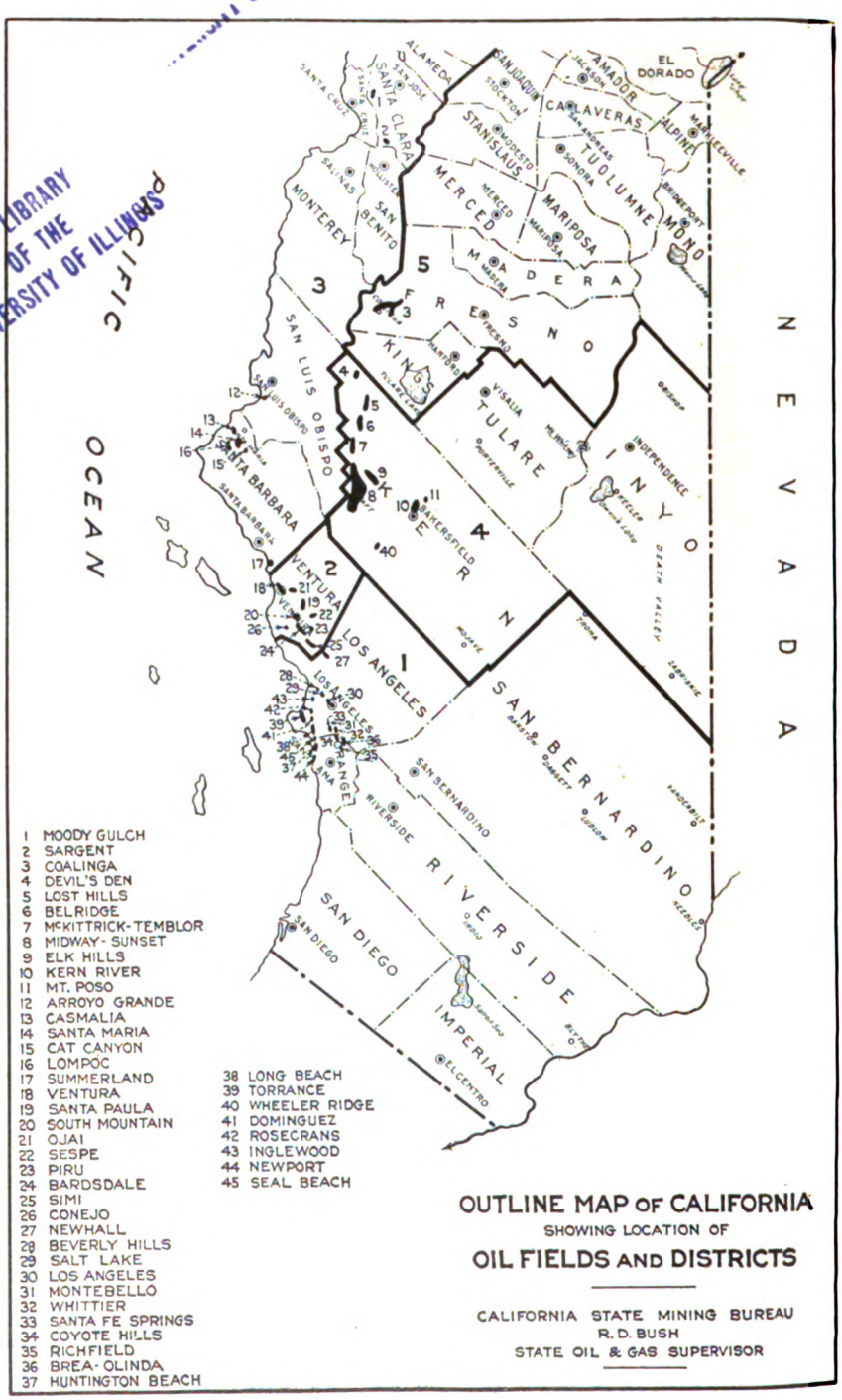

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Financial and Operating Conditions of California Oil Fields, 1926.

Financial results of the oil business during 1926 are shown by the following tables. The features worthy of mention are: (1) The higher price received for the year as shown by the state average of all grades, but especially the lighter gravities. (2) Decreases in the dividends paid by companies operating in all counties except Orange; but the total of dividends paid by the miscellaneous and marketing companies continued at approximately the same amount as in 1925. (3) Decreases in the number of barrels per well per day yield (see Table I) in most of the older fields, with marked drops in Los Angeles and Orange counties. (4) Somewhat higher operating costs per barrel in most of the fields.

With reference to Table I, it should be noted that although it lacks data from the larger operators who have refineries and with interests in more than one field, yet the data given are of economic value and interest in that they indicate the conditions prevailing among the smaller companies and operators.

Operating cost per well is not always lower for the dividend companies than others. Profitable operations seem to depend generally upon large wells, high-grade oil, and proximity to market. Price and profits have usually been greater in the Los Angeles-Orange-Ventura fields than in others, doubtless largely due to the proximity to market and higher grades of oil. Crude oil testing as high as 56° Baumé is obtained from some of the Ventura wells.

TABLE G. CAPITALIZATION.

Field	Number of companies considered*	Per cent of total product of field	Capital	
			Cash	Property
Fresno County—Coalinga	45	13	$2,292,374	$5,756 204
Kern County:				
Kern River	37	38	8,058,269	4,930,514
Midway	60	37	10,736,465	39,500,777
Sunset and Maricopa	30		4,347,012	6,291,047
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	40	17	3,553,416	4,386,316
Los Angeles County	98	12	19,167,281	26,412.300
Orange County	37	10	4,289,732	12,232,744
Santa Barbara County	19	39	2,003,696	3,471,173
Ventura County	35	13	2,226,475	9,394,593
Subtotals	401	--	$56,674,620	$112,475,677
Miscellaneous and marketing companies†	90	67	91,523,811	980,568,817
Totals	491	----------	$148,198,441	$1,093,044,494

*See Table I, following.

†Includes companies having refineries, and those operating in several fields whose data could not be segregated as to counties or fields.

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TABLE H. Dividends Paid by Oil Companies. 1921-1926.

Field	1921		1922		1923		1924		1925		1926	
	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value	Companies	Value
Fresno County—												
Coalinga	24	$1,142,767	20	$893,210	17	$383,675	13	$239,985	20	$815,625	13	$300,799
Kern County—												
Kern River	28	390,794	20	594,306	13	187,170	20	67,468	20	1,083,147	15	156,517
Midway	34	4,311,539	30	2,706,985	19	2,438,695	31	3,528,930	27	5,078,020	22	5,021,540
Sunset, Maricopa and Wheeler Ridge	18	960,459	19	936,174	11	259,569	13	739,494	13	306,089	6	563,557
McKittrick, Belridge, Lost Hills, Devils Den, Elk Hills	13	2,603,490	10	733,460	11	1,021,602	5	1,594,497	6	762,526	11	795,435
Los Angeles County	11	562,224	16	1,442,470	32	5,627,346	34	3,458,221	36	9,172,047	41	4,169,848
Orange County	11	1,395,158	8	331,345	12	897,119	11	2,717,050	15	1,194,391	11	1,442,884
Santa Barbara County	5	400,535	5	317,014	3	163,600	3	221,916	2	124,267	2	124,200
Ventura County	6	1,362,210	7	1,204,631	4	126,784	4	303,000	5	438,407	6	268,607
Subtotals	150	$13,129,176	135	$9,159,595	122	$11,105,560	134	$12,870,561	144	$18,974,519	127	$12,831,387
Miscellaneous and marketing companies [a]	11	35,886,119	10	41,030,594	10	44,398,555	36	52,150,372	27	53,459,294	28	53,231,591
Totals	161	$49,015,295	145	$50,190,189	132	$55,504,115	170	$65,020,933	171	$72,433,813	155	$66,062,978

[a] See Table G, preceding.

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TABLE I. Average Prices of Light and Heavy Oils, and Operating Data, 1926.

Field	Price				Operating data					
					All companies considered *			Dividend companies ▲		
	Under 18° Baume	18° and over	Average price	Price to dividend companies	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel	Barrels per well per day yield	Operating cost per well day	Operating cost per barrel
Fresno County—										
Coalinga	$0.776	$1.103	$0.815	$0.892	10.3	$5.35	$0.521	10.7	$6.13	$0.572
Kern County—										
Kern River	0.792	----------	0.792	0.777	7.0	2.50	0.357	6.4	2.07	0.323
Midway	0.752	1.981	1.779	1.824	36.5	16.17	0.443	39.2	15.87	0.405
Sunset and Maricopa	0.761	1.378	0.800	0.837	21.9	10.39	0.475	25.4	7.27	0.286
McKittrick, Lost Hills, Belridge, Devils Den, Elk Hills	0.803	0.973	0.919	0.926	26.3	6.97	0.265	32.3	8.00	0.248
Los Angeles County	0.860	1.676	1.645	1.703	71.3	43.36	0.608	68.1	33.35	0.490
Orange County	1.038	1.602	1.559	1.659	70.1	27.97	0.399	73.0	26.94	0.369
Santa Barbara County	0.743	1.264	0.793	0.818	39.0	12.92	0.331	43.6	8.41	0.193
Ventura County	0.759	1.517	1.512	1.605	22.2	16.86	0.760	24.6	18.44	0.750

*See Table G, preceding. Does not include companies with refineries, nor those operating in several fields whose data could not be segregated as to counties or fields. The data given are of value, however, as showing the conditions obtaining among the smaller operators.

▲ See Table H, preceding.

It should be noted that in the case of a county like Ventura, with only a few producers, the averages are not so significant as in other fields with a large number of operators. The figures of a single large operator in such a case can materially affect the general average if they should be much above or below the average of the others.

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Proved Oil Land.

The total proved oil land of the state is 121,435 acres, a decrease during 1926 of one acre. Of this 1926 total, 22,493 acres, being owned by Federal, State, and City governments, or for other reasons, is not assessable for the support of the Department of Petroleum and Gas of the State Mining Bureau. The acreage in 1926 was distributed by counties as follows:

TABLE J.

Proved Oil Lands and Number of Wells, 1926.

County	*Land (acres)*	*Number wells Dec. 31, 1926*
Fresno	14,665	931
Kern	77,502	5,309
Los Angeles*	10,041	2,976
Orange	6,536	1,165
San Luis Obispo	402	18
Santa Barbara	7,394	291
Santa Clara	80	9
Ventura	4,815	579
Kings, San Bernardino, San Mateo, Sonoma	------	3
Totals	121,435	11,281

* Not including the old Los Angeles City field.

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CHAPTER THREE.

METALS.

Bibliography: Reports of State Mineralogist I–XXII (inc.). Bulletins 5, 6, 18, 23, 27, 36, 50, 57, 76, 78, 85, 92, 95. Spurr and Wormser, "Marketing of Metals and Minerals." See also under each metal.

The total value of metals produced in California during 1926 was $20,928,744. The chief of these is, and always has been, gold, followed in 1926 by copper, zinc, silver, lead, quicksilver, tungsten, platinum and manganese ore. There was a small output of iron ore and antimony. There was no production of arsenic, cadmium, molybdenum, nor tin, which have in the past been on the active list. Deposits of ores of nickel and vanadium have also been found in the state; although there has yet been no commercial output of them. The above-noted total of this group is a net decrease of $3,475,050 from the 1925 total of $24,403,794, due mainly to decreases registered by copper, gold and silver, in spite of increases by lead and zinc.

California leads all states in the Union in her gold production and is credited with approximately 30% of the nation's yield in 1926. The precious metal is widely distributed through the state. Thirty-four of the fifty-eight counties reported an output in 1926 from either mines or dredges.

Copper, which is second in importance among the metals of the state, occurs in the following general districts: the Shasta County belt, which has been by far the most important; the Coast Range deposits, extending more or less continuously from Del Norte in the north to San Luis Obispo County in the south; the Sierra Nevada belt, starting in Plumas and running in a general southerly and southeasterly direction through the Mother Lode counties and ending in Kern; the eastern belt in Mono and Inyo counties, and the southern belt, in San Bernardino, Riverside and San Diego counties.

Silver is not generally found alone in the state, except notably in the Rand district, San Bernardino County; but is associated to a greater or less extent with gold, copper, lead, and zinc.

Quicksilver has for many years been one of the state's staple products and California has supplied approximately 75% of the nation's output of this metal.

Tungsten is found in but few other localities of importance in the United States.

Large deposits of iron ore have long been known in several sections of the state, but for various economic reasons this branch of the mineral industry thus far has made only slight progress on the Pacific Coast.

Although the United States is a large consumer of certain metals, in fact the largest particularly of chromium and tin, our production from domestic sources is deficient. We have large reserves of low-grade chromite, manganese, tungsten, and antimony ores, but they can not fully supply our commercial needs. In 1925 the United States required,[1] to satisfy its trade demands, fully 60% of the world's pro-

[1] U. S. Bureau of Mines, Press Bulletin, July 9, 1927.

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duction of chromite, 52% of that of tin, and 30% of that of antimony, but our production of each of these was negligible. We also required 25% of the world's production of mercury, although producing but 10%, and 30% of the world's output of manganese, although we produced only 4.3% from domestic sources.

A comparison of the 1926 metal output with that of 1925 is afforded by the following table:

Substance	1925		1926		Increase+ Decrease—
	Amount	Value	Amount	Value	Value
Copper	46,968,499 lbs.	$6,669,527	33,521,544 lbs.	$4,693,014	$1,976,513—
Gold		13,065,330		11,923,481	1,141,849—
Lead	7,352,422 lbs.	639,661	8,067,873 lbs.	645,429	5,768+
Manganese ore	832 tons	19,450	235 tons	4,700	14,750—
Platinum	292 fine oz.	39,937	306 fine oz.	32,005	7,932—
Quicksilver	7,683 flasks	621,831	5,892 flasks	516,382	105,449—
Silver	3,054,416 fine oz.	2,119,765	2,022,460 fine oz.	1,262,015	857,750—
Tungsten concentrates	573 tons	348,471	441 tons	316,560	31,911—
Zinc	11,546,602 lbs.	877,542	20,447,559 lbs.	1,533,568	656,026+
Unapportioned*		2,280		1,590	690—
Total values		$24,403,794		$20,928,744	
Net decrease					$3,475,050—

*Includes iron ore and antimony.

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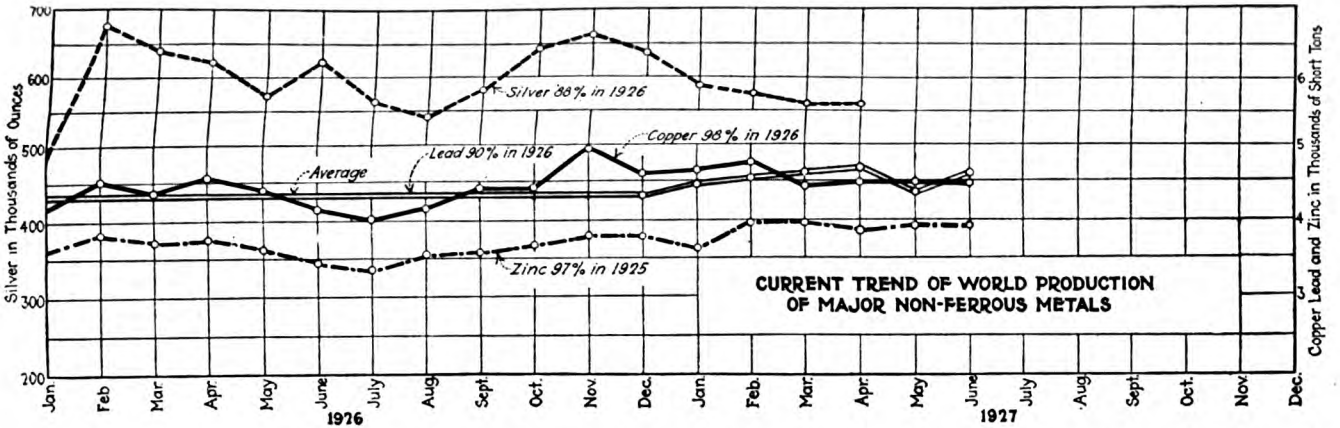

These curves are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The figures for lead on the new basis are not available for the individual months of 1926; and accordingly a horizontal line showing the monthly average reduced to a daily rate is shown. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.—*Eng. and Min. Jour.*, Aug. 13, 1927.

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ALUMINUM.

Bibliography: Report XVIII, p. 198. Bulletins 38, 67. U. S. Geol. Surv., Min. Res. of U. S.

To date there has been no commercial production of aluminum ore in California. Only a single authenticated occurrence of bauxite has thus far been noted in this state, being in Riverside County, southeast of Corona, but as yet undeveloped.

Minerals containing aluminum are abundant, the most widely distributed being the clays. There are only two, however, thus far of consequence, commercially, in the production of the metal: bauxite (to which may be added the related hydrated oxides, hydrargillite and diaspore) and cryolite. Cryolite is found in commercial quantities only in South Greenland, and was formerly the only ore of aluminum used, being still employed as a flux in the extraction of the metal. Bauxite has been, for some years, the most important source of aluminum and its salts. Its color varies from gray to red, according to the amount of iron present, the composition ranging usually between the following limits: Al_2O_3, 30%–60%; Fe_2O_3, 3%–25%; SiO_2, 0.5%–20%; TiO_2, 0.0%–10%. Besides its reduction to the metal, bauxite is also utilized in the manufacture of aluminum salts, refractory bricks, alundum (fused alumina) for use as an abrasive, and in the refining of oil. The most important producing countries, both of bauxite and the metal, are the United States and France, the former yielding more than 60 per cent of the world's output. In 1913 France led.

ANTIMONY.

Bibliography: State Mineralogist Reports VIII, X, XII–XV inc.), XVII, XXII. Bulletins 38, 91.

Production of antimony in California has been irregular, and small in amount except during 1915–17 when the high war-time prices permitted American producers, for a short period, to compete with Chinese antimony. The principal commercial production of antimony in California has come from Kern, Inyo and San Benito counties, and other occurrences have been noted in Nevada, Riverside and Santa Clara counties. The commonest occurrence is in the form of the sulphide, stibnite; but in the Kernville and Havilah districts in Kern County there were notable deposits of the native metal, being among the few localities of the world where native antimony has been found.

California producers claim that they can not operate profitably unless the price of antimony be above 12 cents per pound. During most of 1925 and 1926 the price was up, at times as high as 23¢, and as a consequence there was some revival of antimony mining in California. Present New York quotations (August, 1927) are around 12¢ per pound for Chinese brands. China is the principal world source of antimony.

The antimony market (New York being the chief center) is recognized as one of the most unstable of the metal markets. As the world's requirements for antimony are comparatively small, the prices react sharply if an extra quantity of the metal be thrown onto the market,

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and the trade becomes so cautious that the market may disappear altogether, causing production to fall off rapidly.

Pure antimony metal and manufactured antimony compounds are of considerable importance as pigments in the ceramic industry. The most important use of the metal, commercially, is in various alloys, particularly type-metal (with tin and lead), babbitt (with tin and copper), and britannia metal (with tin and copper). An alloy of 6% antimony and 9.4% lead is being extensively used in making battery plates for storage batteries for automobiles, airplanes, and radio apparatus.

Antimony Production of California, by Years.

The production of antimony in California by years since 1887 has been as follows:

Year	Tons	Value	Year	Tons	Value
[illegible]	75	$15,500	1900	70	$5,700
[illegible]	100	20,000	1901	50	8,350
[illegible]			1902		
[illegible]	50	2,250	1915	510	35,666
[illegible]	150	6,000	1916	1,015	64,793
[illegible]	33	1,485	1917	158	18,786
[illegible]	17	2,320	1918		
[illegible]	20	3,500	1925	*26	770
[illegible]	40	1,200	1926		
[illegible]	75	13,500	Totals	2,389	$199,820

*Annual details concealed under 'Unapportioned.'

ARSENIC.

Bibliography: Report XVIII. Bulletin 67. U. S. G. S., Min. Res. of U. S.

Arsenic is found in a number of localities in California in the mineral arsenopyrite (FeAsS), which is frequently gold bearing; and in scorodite ($FeAsO_4+2H_2O$), an oxidation product of arsenopyrite. The occurrence of realgar (AsS) has also been noted. The principal source of the arsenic of commerce in the United States has been as a by-product from the metallurgical treatment of copper, gold, and lead ores. It is usually recovered in the form of the tri-oxide, or 'white arsenic,' for which there is a demand for the preparation of insecticides, for use in agriculture and horticulture, and especially against the cotton-boll weevil in the southern states.

Except for a small output in 1924, there has been no commercial recovery of arsenic from Californian ores. There having been only a single operator, the figures are concealed under the 'Unapportioned' item.

BERYLLIUM.

Bibliography: Eng. & Min. Jour.-Press, Vol. 118, No. 8, p. 285, Aug. 23, 1924.

Beryllium is a metal resembling aluminum closely in its chemical character, and has a specific gravity of 2.7. Several alloys have been prepared experimentally, of which copper-beryllium has received the most attention. The addition of 5% beryllium produces a golden-yellow

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alloy. The compounds of beryllium at present used commercially are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton, and the oxide has been added to materials being used for the manufacture of abrasive compounds and in dental cements. Beryllium sulphate has been used to some extent in medical research.

There are a number of beryllium minerals, but none have been found in commercial quantities, except beryl, which is a beryllium-aluminum silicate. The chief use at present for ground beryl is as an addition to porcelain products, where it reduces the coefficient of expansion. Beryllium metal is difficult to separate from aluminum.

Beryl occurs in California in the pegmatite dikes of the tourmaline gem district in northern San Diego and southwestern Riverside counties. Thus far there have been no commercial shipments of beryl except for gem purposes (the pink and aquamarine varieties).

BISMUTH.

Bibliography: Bulletins 38, 67, 91. Am. Jour. Sci., 1903, Vol. 16.

Several bismuth minerals have been found in California, notably native bismuth and bismite (the ochre) in the tourmaline gem district in San Diego and Riverside counties near Pala. Other occurrences of bismuth minerals, including the sulphide, bismuthinite, have been noted in Inyo, Fresno, Nevada, Tuolumne, San Bernardino, and Mono counties, but only in small quantities. The only commercial production recorded was 20 tons valued at $2,400, in 1904, and credited to Riverside County. Recovery of bismuth from blister copper in the electrolytic refinery has been noted. In the United States, the principal recovery of bismuth is obtained as a by-product from the refining of lead bullion.

The uses of bismuth are somewhat restricted, being employed principally in the preparation of medicinal salts, and in low melting-point or cliché alloys. These alloys are utilized in automatic fire sprinkler systems, in electrical fuses, and in solders.

Present quotations for bismuth are around $2.00 per pound for the refined metal.

CADMIUM.

Bibliography: U. S. Geol. Surv., Min. Res. of U. S., 1908, 1918.

During 1917 and 1918, cadmium metal was recovered by the electrolytic zinc plant of the Mammoth Copper Company in Shasta County. It was shipped in the form of 'sticks' and amounted to a total of several thousand pounds for the two years, the exact figures being concealed under 'Unapportioned.' That was the first, and thus far the only, commercial production of cadmium recorded from Californian ore. Cadmium occurs there associated with zinc sulphide, sphalerite. Cadmium also occurs in the Cerro Gordo Mine, Inyo County, associated with smithsonite (zinc carbonate).

There are several cadmium minerals, but none of them occur in sufficient quantities individually to be profitable as distinct ores. The cadmium of commerce is derived as a by-product in the reduction of zinc minerals and ores, in nearly all of which it occurs in at least minute

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proportions, the average ratio being about 1 of cadmium to 200 of zinc. As cadmium behaves metallurgically much the same as zinc, it constitutes a fraction of 1 per cent of nearly all metallic zinc.

Cadmium is produced in the United States in two forms—metallic cadmium and the pigment, cadmium sulphide. The principal use of the metal is in low-melting point, or cliché alloys, and its salts are utilized in the arts, medicine, and in electroplating. The sulphide is employed as a paint pigment, being a strong yellow, which is unaffected by hydrogen sulphide gas from coal smoke. It is also employed in coloring glass and porcelain. Cadmium cliché metal is stated to be superior to the corresponding bismuth alloy, for making stereotype plates. Cadmium is also used in bronze telegraph and telephone wires, and gives some promise of being utilized in electroplating.

Present quotations for cadmium are 60¢ per pound for the refined metal.

COBALT.

Bibliography: Report XIV. Bulletins 67, 91. U. S. G. S., Min. Res. of U. S., 1912, 1918.

Occurrences of some of the cobalt minerals have been noted in several localities in California, but to date no commercial production has resulted. Some of the copper ores of the foothill copper belt in Mariposa and Madera counties have been found to contain cobalt up to 3%. The most notable occurrence thus far found in this state is in the Mar-John Mine near Sheep Ranch, Calaveras County. Lenses of smaltite ($CoAs_2$), have been uncovered in the vein, there, and several tons taken out in the course of development work; but as yet there have been no commercial shipments.

The most important use of cobalt is in the manufacture of the alloy, stellite, in which it is combined with chromium, for making high-speed lathe tools, and non-tarnishing cutlery and surgeons' appliances. The metal is also used in electroplating, similarly to nickel; and the oxide, carbonate, chloride, sulphate and other salts are used in ceramics for coloring. Some of the organic salts of cobalt (acetate, resinate, oleate) are employed as 'driers' in paint and varnish.

The nominal quotation for cobalt is around $2.50 per pound for the refined metal.

COPPER.

Bibliography: State Mineralogist Reports VIII–XXII (inc.). Bulletins 23, 50, 91.

Copper is second only to gold among the metals produced in California. The output for 1926 amounted to a total of 33,521,544 pounds of recoverable metal valued at $4,693,014, a decrease from the 1925 figures of 46,968,499 pounds and $6,669,527. The average price was slightly lower (14.0¢ per pound against 14.2¢) than in 1925. The 1924 price was 13.1¢ per pound.

As for several years past, Plumas County ranked first for 1926, with an output of 22,163,035 pounds; Calaveras, second, with 5,240,927 pounds; and Shasta, third, with 5,113,114 pounds; Shasta and Calaveras changing places compared with their 1925 positions.

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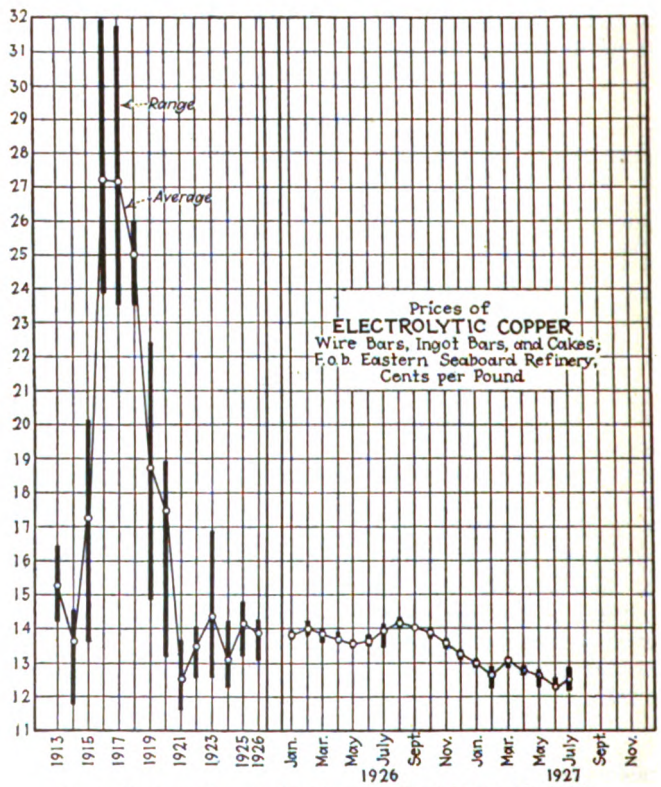
Distribution of the 1926 copper output, by counties, was as follows:

County	Pounds	Value
Calaveras	5,240,927	$733,730
Inyo	42,462	5,945
Mono	2,628	368
Plumas	22,163,035	3,102,825
Riverside	22,125	3,096
San Bernardino	171,232	23,972
Shasta	5,113,114	715,836
Trinity	760,140	106,420
Amador, Mariposa, Napa, Nevada, Orange, San Diego, Tuolumne*	5,881	822
Totals	33,521,544	$4,693,014

* Combined to conceal output of a single operator in each.



From Engineering and Mining Journal, Aug. 13, 1927.

Copper Production of the United States.

According to preliminary data issued by the U. S. Bureau of Mines,[1] the smelter production of primary copper from domestic sources during 1926 amounted to 1,739,622,094 pounds, an increase of approximately 4%. The value of smelter production increased approximately 2% in 1926. The average price of 2,751,000,000 pounds of copper delivered during the year, as reported to the Bureau of Mines by selling agencies, was 14.0¢ per pound.

[1] U. S. Bureau of Mines, Press Bulletin, July 6, 1927.

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"Refined Copper.

"The total production of new refined copper in 1926 was 2,322,000,000 pounds, an increase of 118,000,000 pounds over that in 1925.

"Primary and secondary copper produced by regular refining plants and imported, 1925–1926, in pounds:

	1925	1926
"Primary:		
Domestic:[a]		
Electrolytic	1,533,995,439	1,553,041,424
Lake	138,029,764	172,372,304
Casting	10,870,144	5,883,433
	1,682,895,347	1,731,297,161
Foreign:[a]		
Electrolytic	516,632,530	588,932,788
Casting	5,045,947	2,255,427
Refinery production of new copper	2,204,573,824	2,322,485,376
Imports of refined copper	99,773,546	170,565,766
Total new refined copper made available	2,304,347,370	2,493,051,142
Secondary:		
Electrolytic	140,349,541	163,061,465
Casting	58,010,653	62,056,941
	198,360,194	225,118,406
	2,502,707,564	2,718,169,548

[a] The separation of refined copper into metal of domestic and foreign origin is only approximate, as an accurate separation of the amounts at this stage of manufacture is not possible.

"In addition to their output of metallic copper the regular refining companies produced bluestone (hydrous copper sulphate) having a copper content of 8,498,000 pounds, as compared with 6,754,000 pounds in 1925.

"Stocks.

"Stocks of Copper January 1, 1922, 1923, 1924, 1925, 1926, and 1927, in Pounds.

Year	*Refined copper*	*Blister and material in process of refining* [a]
1922	459,000,000	283,000,000
1923	216,000,000	361,000,000
1924	264,000,000	432,000,000
1925	243,000,000	393,000,000
1926	124,000,000	432,000,000
1927	146,000,000	455,000,000

[a] "The amounts stated in the last column in the table above do not include copper in stock at foreign smelters or in transit from foreign smelters to refineries in the United States."

Copper Production of California by Years.

Although some mining of copper ores in a small way had been done earlier, shipments in appreciable quantities began in 1861 and continued of importance up to the end of 1867, when a total of 68,631 tons (of 2376 pounds) of high-grade ores, and 847 tons of matte or 'regulus'[1] had been shipped to smelters at New York, Boston, and Swansea, Wales. The most important district at that time was Copperopolis and vicinity in Calaveras County, with some shipments also made from Mariposa, El Dorado, Fresno, and San Luis Obispo counties. From 1868 to 1882, the output was insignificant. There are wide discrepancies in the figures currently recorded for copper production previous to 1882 in which year the data of the U. S. Geological Survey began. The detailed statistics of the California State Mining Bureau began in the year 1894.

[1] Brown, J. Ross, Mineral resources west of the Rocky Mountains, p. 168, 1867.

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Amount and value of copper production in California annually since 1882 is given in the following tabulation:

Year	Pounds	Value	Year	Pounds	Value
1882	826,695	$144,672	1905	16,997,489	$2,650,605
1883	1,600,862	265,743	1906	28,726,448	5,522,712
1884	876,166	120,911	1907	32,602,945	6,341,387
1885	469,028	49,248	1908	40,868,772	5,350,777
1886	430,210	43,021	1909	65,727,736	8,478,142
1887	1,600,000	192,000	1910	53,721,032	6,680,641
1888	1,570,021	235,303	1911	36,838,024	4,604,753
1889	151,505	18,180	1912	34,169,997	5,638,049
1890	23,347	3,502	1913	34,471,118	5,343,023
1891	3,397,405	424,675	1914	30,491,535	4,055,375
1892	2,980,944	342,808	1915	40,968,966	7,169,567
1893	239,682	21,571	1916	55,809,019	13,729,017
1894	738,594	72,486	1917	48,534,611	13,249,948
1895	225,650	21,901	1918	47,793,046	11,805,883
1896	1,992,844	199,519	1919	22,162,605	4,122,246
1897	13,638,626	1,540,666	1920	12,947,299	2,382,303
1898	21,543,229	2,475,168	1921	12,088,053	1,559,358
1899	23,915,186	3,990,534	1922	22,883,987	3,090,582
1900	29,515,512	4,748,242	1923	28,346,860	4,166,989
1901	34,931,788	5,501,782	1924	52,089,349	6,823,704
1902	27,860,162	3,239,975	1925	46,968,499	6,669,527
1903	19,113,861	2,520,997	1926	33,521,544	4,693,014
1904	29,974,154	3,969,995	Totals	1,016,344,705	$164,270,501

GOLD.

Bibliography: State Mineralogist Reports I to XXIII (inc.), (except III and VIII). Bulletins 36, 45, 57, 91, 92, 95. U. S. Geol. Surv., Prof. Paper 73.

Gold was the first, and, for many years, the most important single mineral product of California. Although now surpassed for a number of years in annual value by petroleum, and by cement beginning with 1920, it still heads our metal list, and California continues to outrank all the other gold-producing states of the United States, including Alaska. In fact, at present, California is producing approximately 30% of the gold mined in the entire United States.

While there is some renewal of activity in the development of gold lode properties, it has not yet become reflected in an increased yield of the metal. In fact, the 1926 figures show a decrease from the 1925 values.

The gold yield has decreased in recent years, not only in California but in the country as a whole. Meanwhile, the actual gold reserves (monetary stock on hand) of the United States has increased to such an extent that we now hold practically one-half of the world's stock. A recent editorial in one of our metropolitan dailies is interesting and pertinent in this connection:[1]

"The fact that the United States hold about one-half of the world's monetary stock of gold strikes the mind of the average reader as another sign of his country's greatness, but one by which his daily life is affected not nearly so much as by some others. For instance, the fact that 80 per cent of the world's automobiles are in the United States. He has some relation, usually a pleasant one, to the automobiles, but the billions of gold stored away in Treasury and Federal reserve bank vaults do not seem to mean much in his daily routine.

"Yet that hidden stock of gold is the power house of the vast circulating system of exchange, currency and instruments of credit, which keep the business of the Nation going, by which wages are paid and profits computed. It means much to the work-a-day citizen that what he receives for his services or his goods is a promise to pay which he in turn can exchange for the services or goods he requires. And

[1] San Francisco Chronicle, July 18, 1927.

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it can be so exchanged indefinitely because it is secured by a commodity that measureably holds its value. That commodity is the gold reserve of the country.

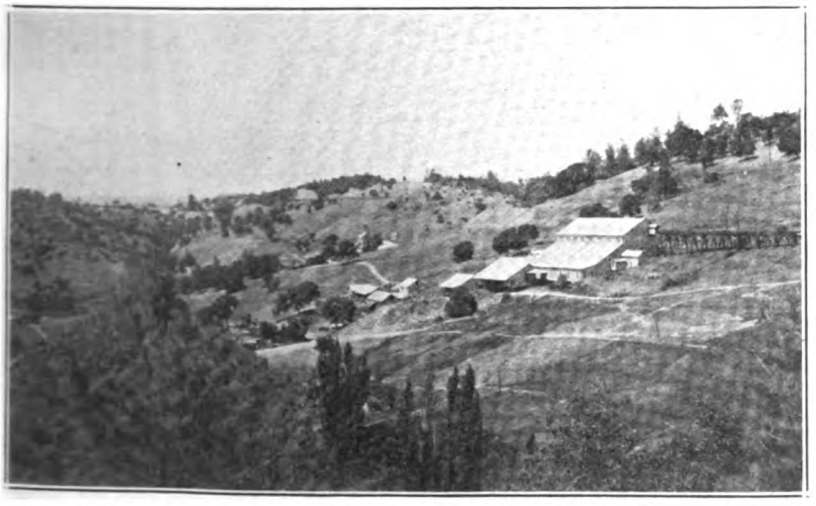
"Since 1913 the gold reserve in the United States has doubled. At the same time the world production of gold has fallen from about 480 million dollars in 1915 to 400 million in 1926. Of the total output, South Africa now produces about one-half, while the United States and Canada coming next produce about one-tenth each. At the present rate of production the stock of gold needed as a basis for currency and credits will eventually fall short of the growing needs due to the increase in population and the expansion of business. The result of such a shortage would be dear money which would mean cheap commodities and a tendency to lower the price of personal service. It was just such a situation which brought on the Bryan agitation for cheap money through legislation. That situation was changed by the unexpected increase in the gold output through new gold finds, but more especially through improvement in extracting gold from low-grade ores.

"Joseph Kitchin, the British expert, estimates that the world's stock of monetary gold needs to increase 2.7 per cent annually to keep abreast of economic development.

"On the other hand, no one can foresee the future as to discovery of new gold fields or development of cheaper methods of utilizing low-grade ores.

"Furthermore, centralization of reserves has made gold much more efficient as a basis of currency, a given amount now being sufficient to sustain nearly twice as much circulating medium as was the case a few years ago. It has made it possible to extend the use of solvent credits as the basis of circulation, and in a certain measure to use the gold in this country to sustain currency in other countries to which we extend credit.

"Yet the flow of gold into the United States has been so strong that we now have a basis for our circulation more nearly 100 per cent than the 40 per cent legally required. Patently this is unnecessary, and in itself suggests grave problems. But there remains assurance in the fact that in the event of another period of gold shortage this country is in a position relatively so strong to meet the problems."



View of the Mother Lode in Amador County; Bunker Hill Mine in right foreground. Photo by C. A. Logan.

Distribution of the 1926 gold production, by counties, was as follows:

Gold Production, by Counties, 1926.

County	*Value*	*County*	*Value*
Amador	$2,167,275	Nevada	$2,318,846
Butte	287,853	Orange	60
Calaveras	576,889	Placer	82,921
Del Norte	1,078	Plumas	247,667
El Dorado	91,789	Riverside	2,931
Fresno	8,595	Sacramento	1,304,046
Humboldt	1,243	San Bernardino	106,875
Imperial	238	San Diego	10,543
Inyo	26,871	Santa Cruz	143
Kern	135,508	Shasta	132,906
Lassen	67	Sierra	564,452
Los Angeles	94	Siskiyou	141,240
Madera	1,708	Stanislaus	127,398
Mariposa	182,313	Trinity	483,471
Modoc	158	Tuolumne	119,873
Mono	20,204	Yuba	2,769,703
Monterey	706		
Napa	7,817	Total value	$11,923,481

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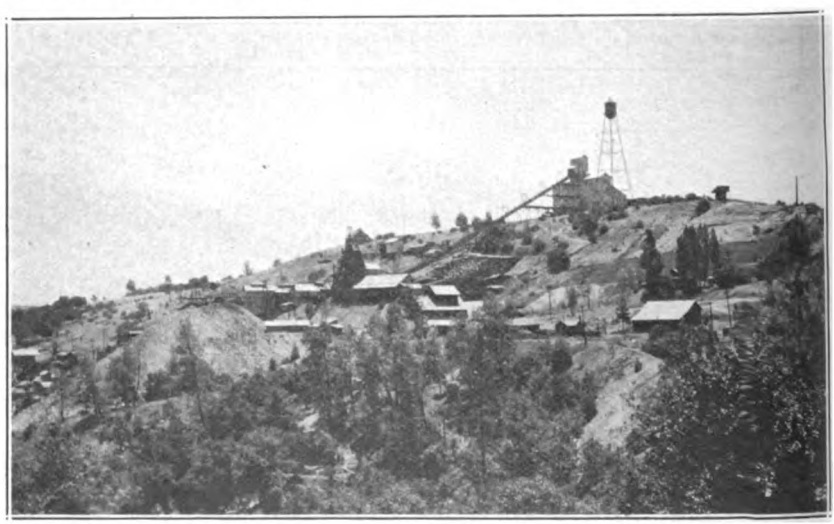
The production of gold in California in 1926 totaled 576,798.40 fine ounces, worth $11,923,481, being a decrease of 55,236.91 fine ounces from the 1925 yield. The 'deep' or lode mines accounted for $6,695,078, and the placers (mainly the dredgers) produced $5,228,403. As the State Mining Bureau has never independently gathered the statistics of gold and silver production, these figures, as in former years, are published by cooperation with and through the courtesy of Mr. J. M. Hill of the Division of Minerals and Statistics, U. S. Bureau of Mines.

The largest gold production for 1925 is reported from Yuba County, with an output of 133,984.39 fine ounces ($2,769,703). Nevada County, with 112,174.19 ounces ($2,318,846), was second; Amador County, 104,841.95 ounces ($2,167,275), third; Sacramento County, 63,083.24 ounces ($1,304,046), fourth; followed by Calaveras and Sierra counties in fifth and sixth places, respectively. It will be noted that Yuba County retained its position of first place, and that Nevada and Amador



Argonaut Mine and Mill, near Jackson, Amador County. Photo by C. A. Logan.

exchanged second and third, compared with the 1925 standing. The Yuba County production is almost entirely from dredges, while that from Nevada and Amador is mainly lode gold.

The following is quoted from the advance chapter on Gold in 1926, by courtesy of Mr. J. M. Hill of the U. S. Bureau of Mines:

"The value of the gold produced in California in 1926 was $11,923,481, a decrease of $1,141,849 or 9 per cent as compared with 1925. Lode mines yielded 56 per cent and placer mines 44 per cent of the total gold in 1926 as compared with 61 per cent and 39 per cent in 1925 and 65 per cent and 35 per cent, respectively, in 1924.

"Four counties produced more than $1,000,000 in gold in 1926 as compared with 5 counties in 1925, for Sierra County mines did not reach the million mark in 1926. Yuba, with $2,769,703, produced largely by dredges, was first in rank; Nevada, with $2,318,846, largly from gold lode mines, was second; Amador, with $2,167,275, almost entirely from gold lode mines, was third; and Sacramento, with $1,304,046, entirely from placer mines, mostly dredges, was fourth. The next largest output of gold, $576,889, came from Calaveras County, largely from gold lode mines and one dredge operation, followed by Sierra County with $564,452, practically all from gold lode mines, and by Trinity County with $483,471, largely from dredge and hydraulic placer mines, but with more lode gold output than in 1925.

"In 1926 there were 34 companies in the state that produced more than 1000 ounces of gold each and these contributed 90 per cent of the total gold output of the state. This is a decrease of 7 mines as compared with the 41 mines that produced over 1000 ounces in 1925. It is also noteworthy that the proportion of the state total produced at large mines has decreased from 90 per cent in 1925 to 82 per cent in 1926. In other words, more small mines are producing than a year ago. Of these

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9 produced more than 20,000 ounces and 3 more than 50,000 ounces. Of these 34 companies 11 operated 22 gold dredges, 1 a drift placer mine, 1 a silver mine, 2 operated copper mines and 19 operated gold lode mines. The 10 largest gold-producing companies in California in 1926, in order of output, were the Yuba Consolidated Gold Fields (6 dredges), Natomas Co. of California (6 dredges), Empire Mines Co. (gold lode), Kennedy Mining and Milling Co. (gold lode), North Star Mines Co. (gold lode), Central Eureka Mining Co. (gold lode), Argonaut Mining Co. (gold lode), Carson Hill Gold Mines (Inc.) (gold lode), Sixteen to One Mine Co. (gold lode), and the Estabrook Gold Dredging Co. (1 dredge).

"The yield of gold from placer mines in 1926 was valued at $5,228,403, an increase of 3 per cent as compared with 1925. There was an increased gold yield of 4 per cent by dredges and 67 per cent by drift mines, but decreases of 61 per cent and 6 per cent by hydraulic and surface mines, respectively, as compared with 1925. In 1926 dredges yielded 95 per cent, drift mines 2 per cent, hydraulic mines 1 per cent, and surface workings 2 per cent of the gold from California placer deposits. Production of gold by 23 dredges in 1926 was $4,950,545 as compared with $4,750,842 in 1925. There was a large increased output by dredges in Yuba and Trinity counties and smaller increases in Shasta, Sacramento, and Placer counties, but declines in the gold yield from dredges in Butte, Calaveras and Stanislaus counties. Gold produced at 75 drift mines in 1926 was valued at $111,236 as compared with $66,523 in 1925. Increases in gold from drift mines were recorded from Butte, Calaveras, El Dorado, Placer, Plumas, Trinity and Yuba counties, but decreases from drift mines in Mariposa, Nevada, Sacramento, Shasta, and Tuolumne counties. Drift mines in Amador and Fresno counties were productive in 1926 but not in 1925. Gold produced at 79 hydraulic mines in 1926 was valued at $69,139 as compared with $175,345 in gold from 98 mines in 1925. The gold output of hydraulic mines in 1926 decreased in Siskiyou County by $31,984, in Trinity by $16,970, in Sierra County by $15,740, in Nevada County by $19,611, in Humboldt County by $12,214, and by less than $10,000 in Amador, Plumas, Shasta, and Yuba counties. Hydraulic mines in Butte, Calaveras and Del Norte counties reported production in 1926 but none in 1925. Gold was produced by 306 surface mines in 1926 as compared with 168 surface or sluice operations in 1925. The total gold yield from this class of mines in 1926 was $97,483 as compared with $103,434 in 1925. In virtually all the mining counties of the state gold is recovered by itinerant placer prospectors and it is very difficult to apportion properly the gold produced by them.

"Placer mines in Yuba County increased their production of gold by $201,797, in Trinity County by $44,607, in Plumas County by $14,312, and in Calaveras, Placer and Shasta counties by approximately $10,000. Decreases in placer yield for 1926 as compared with 1925 were recorded in Stanislaus County ($44,344), Siskiyou County ($27,162), Butte County ($19,828), Nevada County ($19,142), Fresno County ($16,991), Sierra County ($14,030), Humboldt County ($11,899) and Amador County ($5,170).

"The output of gold from 335 lode mines in California in 1926 was valued at $6,695,078, a decrease of 16 per cent as compared with 1925, following a decrease of 7 per cent for the previous year. The output of gold from the lode mines of both Amador and Nevada counties was more than $2,000,000. Sierra County, with more than $1,000,000 lode gold yield in 1925, dropped to $546,974 in 1926, ranking just above Calaveras County, whose lode mines produced $510,208 in 1926. Plumas County lode mines produced more than $200,000 in gold, and over $100,000 each in gold was produced by lode mines in Kern, Mariposa, San Bernardino, Siskiyou and Tuolumne counties. Lode mines of most counties were less productive than in 1925, the greatest loss being $795,223 in Sierra County, followed by $165,656 in Amador County, $111,982 in Shasta County, $85,559 in Calaveras County, $51,742 in San Bernardino County, $49,344 in Placer County, $39,560 in Tuolumne County, $16,185 in Plumas County, $11,718 in Siskiyou County and $6,721 in Mariposa County. Nevada County lode mines in 1926 produced $32,381 more than in 1925 and there was an increased production of $965 in gold from Kern County mines.

"Gold ore and tailings treated in 1926 yielded $6,334,908 or 95 per cent, copper ore and tailings yielded $232,210 or 3 per cent, silver ore and tailings yielded $84,126 or 1 per cent, and lead and zinc ores 1 per cent of the total gold from lode mines. Amalgamation mills in 1926 recovered approximately 75 per cent, cyanidation plants 17 per cent, and smelters 8 per cent of the lode gold output of California as compared with 72 per cent, 16 per cent and 12 per cent, respectively, in 1925. It is estimated that approximately 6 per cent of the gold output from lode mines was stolen and sold by 'high graders' in 1926."

Total Gold Production of California.

The presence of gold in stream gravels near Los Angeles was known and worked in a small way by the Indians, at least as early as 1841,[1] and possibly 1820.[2] On March 2, 1844, Don Manuel Castanares, deputy for California to the Congress of Mexico, reported[3] to his government that placers near Los Angeles had produced up to December, 1843, a total of 2000 ounces of gold dust, most of which had been sent to the United States mint at Philadelphia.

As the padres and the rancheros discouraged the quest of gold this early, small production caused no particular excitement. It was not until James W. Marshall's finding of gold nuggets in the tail-race of Sutter's saw mill on the American River, January 24, 1848, was heralded

[1] Hittell, T. H., History of California: Vol. II, p. 312, 1885.
[2] Bancroft, H. H., History of California: Vol. II, p. 417, 1886.
[3] Mercantile Trust Review of the Pacific, Vol. XIV, No. 2, p. 43, Feb. 15, 1925.

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abroad that the great rush began, and California became a commonwealth of first rank almost over night. There are, however, no authentic data on gold production prior to 1848, other than occasional, scattered references such as above quoted.

The following table was originally compiled by Chas. G. Yale, of the Division of Mineral Resources, U. S. Geological Survey, but for a number of years statistician of the California State Mining Bureau and the U. S. Mint at San Francisco. The authorities chosen for certain periods were: J. D. Whitney, state geologist of California; John Arthur Phillips, author of "Mining and Metallurgy of Gold and Silver" (1867); U. S. Mining Commissioner R. W. Raymond; U. S. Mining Commissioner J. Ross Browne; Wm. P. Blake, Commissioner from California to the Paris Exposition, where he made a report on "Precious Metals" (1867); John J. Valentine, author for many years of the annual report on precious metals published by Wells, Fargo & Company's Express; and Louis A. Garnett, in the early days manager of the San Francisco refinery, where records of gold receipts and shipments were kept. Mr. Yale obtained other data from the reports of the director of the U. S. Mint and the director of the U. S. Geological Survey. The authorities referred to, who were alive at the time of the original compilation of this table in 1894, were all consulted in person or by letter by Mr. Yale with reference to the correctness of their published data, and the final table quoted was then made up.

The figures for 1903–1923 (inclusive), are those prepared by the U. S. Geological Survey; and since by the U. S. Bureau of Mines:

Year	Value	Year	Value
1848	$245,301	1889	$11,212,913
1849	10,151,360	1890	12,309,793
1850	41,273,106	1891	12,728,869
1851	75,938,232	1892	12,571,900
1852	81,.94,700	1893	12,538,780
1853	67,613,487	1894	13,863,282
1854	69,433,931	1895	15,334,317
1855	55,485,395	1896	17,181,562
1856	57,509,411	1897	15,871,401
1857	43,628,172	1898	15,906,478
1858	46,591,140	1899	15,336,031
1859	45,846,599	1900	15,863,353
1860	44,095,163	1901	16,989,044
1861	41,884,995	1902	16,910,320
1862	38,854,668	1903	16,300,65
1863	23,501,736	1904	18,633,67
1864	24,071,423	1905	18,898,54
1865	17,930,858	1906	18,732,45
1866	17,123,867	1907	16,727,92
1867	18,265,452	1908	18,761,55
1868	17,555,867	1909	20,237,87
1869	18,229,044	1910	19,715,44
1870	17,458,133	1911	19,738,90
1871	17,477,885	1912	19,713,47
1872	15,482,194	1913	20,406,96
1873	15,019,210	1914	20,653,41
1874	17,264,836	1915	22,442,29
1875	16,876,009	1916	21,410,74
1876	15,610,723	1917	20,087,50
1877	16,501,268	1918	16,528,98
1878	18,839,141	1919	16,695,98
1879	19,626,654	1920	14,311,0
1880	20,030,761	1921	15,704,8
1881	19,223,155	1922	14,670,3
1882	17,146,416	1923	13,379,0
1883	24,316,873	1924	13,150,1
1884	13,600,000	1925	13,065,3
1885	12,661,044	1926	11,923,4
1886	14,716,506		
1887	13,588,614	Total value	$1,801,221,9
1888	12,750,000		

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IRIDIUM (see under Platinum).

IRON ORE.

Bibliography: State Mineralogist Reports II, IV, V, X, XII–XV (inc.), XVII, XVIII, XXI, XXII. Bulletins 38, 67, 91. Am. Inst. Min. Eng., Trans. LIII. Min. & Sci. Press, Vol. 115, pp. 112, 117–122; Vol. 123, pp. 94–96, 113–114.

A small tonnage of iron ore was produced in California during the year 1926, and utilized for foundry flux and in steel refining at open-hearth plants. As there was only a single operator, the figures are concealed under the 'unapportioned' total. There is also some tonnage utilized in the manufacture of paint pigment, and which is credited to 'mineral paint' in these statistical reports.

There are considerable deposits of iron ore known in California, notably in Shasta, Madera, Placer, Riverside and San Bernardino counties, but production has so far been limited for lack of an economic supply of coking coal. Some pig-iron has been made, utilizing charcoal for fuel, both in blast furnaces and by electrical reduction; also, ferrochrome, ferromanganese, and ferrosilicon have been made in California.

Total Iron Ore Production of California.

Total iron ore production in California, with annual amounts and values, is as follows:

Year	Tons	Value	Year	Tons	Value
1881*	9,273	$79,452	1912	2,508	$2,508
1882	2,073	17,766	1913	2,343	4,485
1883	11,191	106,540	1914	1,436	5,128
1884	4,532	40,983	1915	724	2,584
1885			1916	3,000	6,000
1886	3,676	19,250	1917	2,874	11,496
1887			1918	3,108	15,947
1903	250	2,000	1919	2,300	13,796
1904	200	1,500	1920	5,975	40,889
1905			1921	1,970	12,030
1907	400	400	1922	3,588	18,868
1908			1923	3,102	18,665
1909	108	174	1924		
1910	579	900	1925	[a] 785	4,710
1911	558	558	1926	[a]	[a]
			Totals	66,533	$526,629

*Productions for the year 1881-1886 (inc.) were reported as "tons of pig iron" (U. S. G. S., Min. Res. 1885), and for the table herewith are calculated to "tons of ore" on the basis of 47.6% Fe as shown by an average of analyses of the ores (State Mineralogist Report IV, p. 242). This early production of pig iron was from the blast furnaces then in operation at Horseling in Placer County. Charcoal was used in lieu of coke. Though producing a superior grade of metal, they were obliged finally to close down, as they could not compete with the cheaper English and eastern United States iron brought in by sea to San Francisco.

[a] Annual details concealed under 'Unapportioned.'

LEAD.

Bibliography: State Mineralogist Reports IV, VIII–XV (inc.), XVII–XXII (inc.).

Production of lead in California in 1926 increased slightly both in quantity and value over the preceding year. As in the past, the principal output was from lead-silver ores in Inyo County. The total recoverable lead in ores shipped from Californian mines in 1926 amounted to 8,067,873 pounds, valued at $645,429, as against 7,352,422

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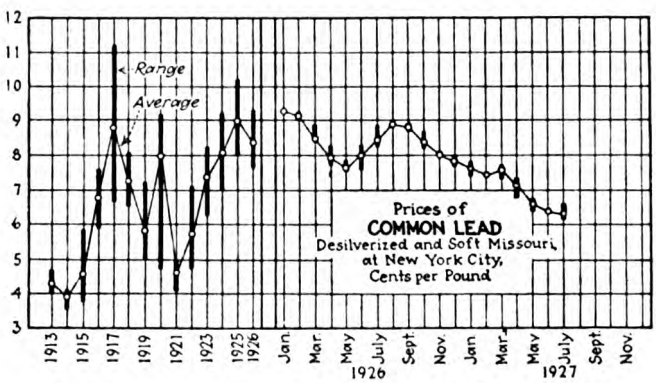
pounds and $639,661 in 1925. The average price of lead in 1926 was 8.0¢ per pound compared to 8.7¢ in 1925 and 8.0¢ in 1924.

The 1926 production was distributed by counties as follows:

Lead Production, by Counties, 1926.

County	*Pounds*	*Value*
Amador	1,267	$101
Inyo	6,541,741	523,339
Los Angeles	1,104,507	88,361
Mono	20,906	1,672
Nevada	4,301	344
Orange	5,176	414
Riverside	173,207	13,857
San Bernardino	195,536	15,643
Shasta	15,584	1,247
Calaveras, Imperial, Plumas, San Diego, Siskiyou, Tuolumne*	5,648	451
Totals	8,067,873	$645,429

* Combined to conceal output of a single operator in each.



From Engineering and Mining Journal, Aug. 13, 1927.

[1] "Refined primary lead produced in the United States in 1926, from domestic ore, amounted to 680,685 short tons, valued at $108,910,000, as shown by reports made by producers to the United States Bureau of Mines, Department of Commerce. The production was 4 per cent greater than in 1925, the value was 4 per cent less, due to a decrease in the average selling value of lead from 8.7 cents a pound in 1925 to 8.0 cents in 1926.

"Nearly one-third of the lead produced from domestic ore was derived from Missouri; a little more than one-fifth was derived from Utah, and a little less than one-fifth was derived from Idaho. The remainder was derived from a number of states, the most important being Oklahoma, Colorado, Montana, and Kansas.

"Refined lead produced from foreign ore, principaly from Mexico, amounted to 118,256 short tons—an increase of 5½ per cent over the production of 1925.

"The apparent consumption of refined primary lead in the United States in 1926 amounted to about 736,000 short tons, as compared with a consumption of about 656,000 tons in 1925."

[1] U. S. Bureau of Mines, Press Bulletin, April 22, 1927.

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Lead Production of California, by Years.

Statistics on lead production in California were first compiled by this Bureau in 1887. Amount and value of the output, annually, with total figures, to date, are given in the following table:

Year	Pounds	Value	Year	Pounds	Value
1887	1,160,000	$52,200	1908	1,124,483	$46,663
1888	900,000	38,250	1909	2,685,477	144,897
1889	940,000	35,720	1910	3,016,902	134,082
1890	800,000	36,000	1911	1,403,839	63,173
1891	1,140,000	49,020	1912	1,370,067	61,653
1892	1,360,000	54,400	1913	3,640,951	160,202
1893	666,000	24,975	1914	4,697,400	183,198
1894	950,000	28,500	1915	4,796,299	225,426
1895	1,592,400	49,364	1916	12,392,031	855,049
1896	1,293,500	38,805	1917	21,651,352	1,862,016
1897	596,000	20,264	1918	13,464,869	956,006
1898	655,000	23,907	1919	4,139,562	219,397
1899	721,000	30,642	1920	4,903,738	392,300
1900	1,040,000	41,600	1921	1,149,051	51,707
1901	720,500	28,820	1922	6,511,280	358,120
1902	349,440	12,230	1923	9,934,522	695,416
1903	110,000	3,960	1924	4,984,387	398,751
1904	124,000	5,270	1925	7,352,422	639,661
1905	533,680	25,083	1926	8,067,873	645,429
1906	338,718	19,307			
1907	328,681	16,690	Totals	133,605,424	$8,728,153

MANGANESE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVIII, XXII. Bulletins 38, 67, 76, 91. U. S. G. S., Bull. 427. Eng. & Min. Jour.-Press, Vol. 117, p. 545.

Manganese ore shipments in California in 1926 amounted to a total of 235 tons of all grades valued at $4,700, being a decrease both in quantity and value from the 1925 yield, which totaled 832 tons and $19,450 value. These ores showed analyses of from 45% to 55% Mn, and were utilized by Pacific Coast plants for ferromanganese.

Importations of foreign manganese ores in 1926, mainly from Brazil, amounted to a total of 368,341 long tons valued at $11,075,771, compared with 299,950 tons and $8,303,855 in 1925. The Tariff Act of 1922 provides for an import duty of 1¢ per pound on the metallic manganese contained, for "manganese ore or concentrates containing in excess of 30 per centum of metallic manganese." The bulk of such ore is consumed in the large steel-producing centers of the eastern United States.

Much valuable research work has been done in recent years, particularly by companies operating in Montana and Virginia, in the beneficiation of manganese ores. The success of their processes appears assured. In reply to the recent suggestion of certain steel interests to have the manganese import duty removed, the manganese operators have organized the American Manganese Producers' Association, which will work for retention of the tariff. Such retention will enable the domestic industry to grow and to further develop ore-dressing methods that will make available large tonnages of low-grade material not now marketable.

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Manganese Ore Production in California, by Years.

Production of manganese ore in California began at the Ladd Mine, San Joaquin County, in the Tesla District in 1867. When shipments of this ore to England ceased late in 1874, upwards of 5000 tons had been produced by that property. For some years following that, the output was small. The tabulation herewith shows California's output of manganese ore, annually, since 1887, when the compilation of such figures was begun by the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1887	1,000	$9,000	1908	321	$5,785
1888	1,500	13,500	1909	3	75
1889	53	901	1910	265	4,235
1890	386	3,176	1911	2	40
1891	705	3,830	1912	22	400
1892	300	3,000	1913		
1893	270	4,050	1914	150	1,500
1894	523	5,512	1915	4,013	49,098
1895	880	8,200	1916	13,404	274,601
1896	518	3,415	1917	15,515	396,659
1897	504	4,080	1918	26,075	979,235
1898	440	2,102	1919	11,569	451,422
1899	295	3,165	1920	2,892	62,323
1900	131	1,310	1921	1,005	12,210
1901	425	4,405	1922	540	7,650
1902	870	7,140	1923	690	10,620
1903	1	25	1924	1,115	25,785
1904	60	900	1925	832	19,450
1905			1926	235	4,700
1906	1	30			
1907	1	25	Totals	87,511	$2,383,554

MOLYBDENUM.

Bibliography: State Mineralogist Reports XIV, XVII. Bulletins 67, 91. U. S. Bur. of Min., Bulletin 111. Proc. Colo. Sci. Soc., Vol. XI.

Molybdenum is used as an alloy constituent in the steel industry, and in certain forms of electrical apparatus. Included in the latter is its successful substitution for platinum and platinum-iridium in electric contact-making and -breaking devices. In alloys it is used similarly to and in conjunction with chromium, cobalt, iron, manganese, nickel, tungsten, and vanadium. The oxides and the ammonium salt have important chemical uses.

The two principal molybdenum minerals are: the sulphide, molybdenite; and wulfenite, lead molybdate; the former furnishing practically the entire commercial output. Molybdenite is found in or associated with acidic igneous rocks, such as granite and pegmatite. The chief commercial sources have been New South Wales, Queensland and Norway, with some also from Canada; but the United States is now able to supply its own requirements.

The growing consumption of molybdenum by alloy-steel makers in the United States has been stimulated by the fact that molybdenum alone of the steel-alloying metals can be produced commercially in the United States to an extent which avoids all necessity for importation. Another fact has been the marked adaptability of molybdenum steels to large-scale production of automobile and other parts.

The most important development of 1924–1925 was the elimination of ferromolybdenum from the market due to the substitution of calcium

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molybdate as the furnace addition by the entire alloy-steel industry. Calcium molybdate is stated to be not only easier and less costly to prepare, but it introduces the molybdenum into the steel bath in a much purer form, the resulting steel being superior to that made with ferromolybdenum.

Deposits of disseminated molybdenite are known in several localities in California, and in at least two places it occurs in small masses associated with copper sulphides. The only recorded commercial shipments of molybdenum ore in California were during the war, 1916–1918. Some development work has been recently done on a high-grade deposit at the head of the Kaweah River, Tulare County.

Present quotations for molybdenum ore are 50¢ per pound for 85% MoS_2 concentrates.

Molybdenum Production of California, by Years.

California's production of molybdenum ore by years is summarized in the following tabulation:

Year	Tons	Value
1916	8	$9,945
1917	243	9,014
1918	*	300
Totals	251	$19,259

* 300 pounds of 90% MoS_2 concentrate.

NICKEL.

Bibliography: State Mineralogist Reports XIV, XVII, U. S. G. S., Bulletin 640-D. U. S. Bureau of Standards, Circular 100.

Nickel occurs in the Friday Copper Mine in the Julian District, San Diego County. The ore is a nickel-bearing pyrrhotite, with some associated chalcopyrite. Some ore has been mined in the course of development work, but not treated nor disposed of, as they were unable to get any smelter to handle it for them. Nickel ore has also been reported from other localities in California, but not yet confirmed.

Present quotations for nickel are around 35¢–39¢ per pound for the refined metal.

OSMIUM (see under Platinum).

PALLADIUM (see under Platinum).

PLATINUM.

Bibliography: State Mineralogist Reports IV, VIII, IX, XII–XVIII. Bulletins 38, 45, 67, 85, 91, 92. U. S. Geol. Surv. Bulletins 193, 285. Trans. Am. Inst. Min. Eng., Vol. 47, pp. 217–218.

In California platinum is obtained as a by-product from placer operations for gold. The major portion of it comes from the dredges working in Butte, Sacramento, Stanislaus, and Yuba counties, with smaller amounts from the hydraulic and surface-sluicing mines of Del Norte, Humboldt, Shasta, Siskiyou, and Trinity.

The production of platinum-group metals in California for the year 1926 totaled 367 ounces, crude, containing 322 fine ounces, valued at $32,005. Of this amount, a total of 260 ounces, crude, or 71%, came

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from the gold dredges. This compares with the 292 fine ounces worth $39,937 sold in 1925.

The above-noted total of 322 fine ounces includes 110 fine ounces of iridium, osmiridium, ruthenium, and palladium. Most of the platinum refiners pay for the osmiridium on the basis of its iridium content. Crude 'platinum' is really a mixture of the metals of that group, and carries varying percentages of platinum, iridium, osmiridium or iridosmine, with occasionally some ruthenium and palladium. In addition to the above-noted production, there is usually some platinum recovered as a by-product in the gold refinery of the mint, but which can not be assigned to the territory of its origin for lack of knowing to which lots of gold it belongs. Some platinum and palladium are also recovered in the electrolytic refining of blister copper.

For 1926, the distribution by counties of California's platinum yield was as follows:

Platinum Production, by Counties, 1926.

County	*Fine ounces*	*Value*
Butte	[a]10	$954
Del Norte	10	1,132
Shasta	28	3,034
Siskiyou	16	1,780
Trinity	28	2,832
Humboldt, Plumas, Sacramento,[b] Stanislaus, Yuba [c] *	230	22,273
Totals	322	$32,005

[a] Includes ruthenium.
[b] Includes ruthenium and palladium.
[c] Includes palladium.
* Combined to conceal output of a single operator in each.

Uses, Markets, and Consumption.

Besides its well-known uses in jewelry, dentistry and for chemicalware, an important industrial development of recent years employs platinum as a catalyzer in the 'contact process' of manufacturing concentrated sulphuric acid. It is also necessary for certain delicate parts of the ignition systems in automobiles, motor boats and aeroplanes. Experiments have been made to find alloys which can replace platinum for dishes and crucibles in analytical work, but so far with only slight success.

According to Hill,[1] the total consumption of platinum metals in the United States in 1926 was 171,616 troy ounces, a slight decrease from that consumed in 1925, distributed as follows:

"Platinum metals consumed in the United States as reported by refiners, 1925 and 1926, by industries, in troy ounces.

Industry	*Platinum*	*Iridium*	*Palladium*	*Others*	*Total*	*Per centage of total*
1925						
Chemical	12,558	71	383	685	13,697	8
Electrical	18,845	1,579	3,157	111	23,692	13
Dental	9,293	95	14,952	----	24,340	14
Jewelry	93,293	2,840	10,950	2,280	109,363	62
Miscellaneous	3,356	220	520	1,414	5,510	3
Totals	137,345	4,805	29,962	4,490	176,602	100
1926						
Chemical	10,253	145	213	228	10,839	6
Electrical	16,765	1,608	3,508	185	22,066	13
Dental	8,542	131	11,063	----	19,736	11
Jewelry	85,908	2,949	7,770	454	97,081	57
Miscellaneous	17,381	581	2,181	1,751	21,894	13
Totals	138,849	5,414	24,735	2,618	171,616	100

[1] Hill, J. M., platinum and allied metals in 1926 U. S. Bur. of Mines, Press Bull., May 4, 1927.

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"Stocks.

"At the end of 1926 stocks of platinum metals in the hands of refiners was 105,571 ounces, an increase of 33 per cent as compared with stocks at the end of 1925, and larger than stocks at any time since the close of the World War.

"Stocks of platinum metals in the hands of refiners in the United States, December 31, 1918–1926 in troy ounces:

Year	*Platinum*	*Iridium*	*Palladium*	*Others*	*Total*
1918	51,504	3,224	10,086	----	64,814
1919	29,228	3,359	10,235	610	43,432
1920	46,747	4,196	16,565	216	67,724
1921	38,514	4,991	21,042	3,113	67,660
1922	41,900	7,559	24,975	1,583	76,017
1923	36,554	5,208	26,266	2,697	70,725
1924	40,464	3,622	27,400	3,053	74,539
1925	44,024	3,720	26,740	4,609	79,093
1926	64,203	3,933	31,950	5,485	105,571

Prices.

Prices of all of the metals of the platinum group fluctuated considerably during 1926, dropping until June, then recovering for a time but dropping again after early October and ending the year at $112 for platinum, $63 for palladium, $120–$125 for iridium. The greatest break was in the iridium market, having started the year at $380–$390 per ounce. The arrival of large supplies from Australia and South Africa broke the price to $200–$215 by May first, following which it continued to decline. The average for the year for platinum was $111 an ounce, for palladium $70 and for iridium $169.

Platinum Production of California, by Years.

The annual production and values since 1887, have been as follows:

Year	Ounces	Value	Year	Ounces	Value
1887	100	$400	1908	706	$13,414
1888	500	2,000	1909	416	10,400
1889	500	2,000	1910	337	8,386
1890	600	2,500	1911	511	14,873
1891	100	500	1912	603	19,731
1892	80	440	1913	368	17,738
1893	75	517	1914	463	14,816
1894	100	600	1915	667	21,149
1895	150	900	1916	886	42,642
1896	162	944	1917	610	43,719
1897	150	900	1918	571	42,788
1898	300	1,800	1919	*418	60,611
1899	300	1,800	1920	477	68,977
1900	400	2,500	1921	613	58,754
1901	250	3,200	1922	795	90,288
1902	39	468	1923	602	78,546
1903	70	1,052	1924	273	36,452
1904	123	1,849	1925	292	39,937
1905	200	3,320	1926	322	32,005
1906	91	1,647			
1907	300	6,255	Totals	14,514	$750,818

QUICKSILVER.

Bibliography: State Mineralogist Reports IV, V, XII–XV, XVII–XXII (inc.). Bulletins 27, 78, 91. U. S. Geol. Surv., Monograph XIII. U. S. Bur. of Mines, Tech. Papers 96, 227; Bulletin 222.

Quicksilver was produced in California in six counties during 1926 to the amount of 5892 flasks (of 75 pounds, avoirdupois) valued at $516,382, being a decrease both in quantity and value compared with the 1925 output of 7683 flasks worth $621,831. The average price

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received during 1926, according to the producers' reports to the State Mining Bureau, was $87.64 per flask, as against $80.81 in 1925 and the record average of $114.03 for the year 1918.

The average of San Francisco quotations for 1926 was $91.58 per flask, the price ranging without sharp fluctuations between $88.67 and $90.00 until the end of September. Beginning with October the quotations advanced sharply to $99.00 in the third week of November, and closing the year at that figure. The advance has continued into 1927, and present quotations are around $120 per flask, in San Francisco. The average of quotations for 1926 in New York was $91.90 per flask.

The above-noted yield of 5,892 flasks in 1926 was won from a total of 43,552 tons of ore, being an average content of 10.14 pounds per ton, or 0.507% mercury.

The U. S. Bureau of Mines reports the total production of the United States for 1926 at 7,645 flasks valued at $702,598 (using $91.90 as the average of New York quotations). Outside of California, the principal yield was from Texas, with a few flasks from Nevada, Arizona, and Idaho. California's contribution was 77% of the total.

The imports of quicksilver in 1926 amounted to 11,768 flasks from Italy and 14,117 flasks from Spain, and from all other countries 2,729 flasks, making a total of 28,614 flasks compared with 22,781 flasks in 1925. The exports were 116 flasks.

Uses.

The most important uses of quicksilver are the recovery of gold and silver by amalgamation, and in the manufacture of fulminate for explosive caps, of drugs, of electric appliances, and of scientific apparatus. By far the greatest consumption is in the manufacture of fulminate and drugs. Radio tubes and electrical appliances are taking increasing amounts.

Total Quicksilver Production of California.

Total amount and value of the quicksilver production of California, as given in available records, are shown in the following tabulation. Though the New Almaden Mine in Santa Clara County was first worked in 1824, and has been in practically continuous operation since 1846 (the yield being small the first two years), there are no available data on the output earlier than 1850. Previous to June, 1904, a 'flask' of quicksilver contained 76½ pounds, but since that date 75 pounds. In compiling this table the following sources of information were used: for 1850–1883, table by J. B. Randol, in Report of State Mineralogist, IV, p. 336; 1883–1893, U. S. Geological Survey reports; 1894 to date, statistical bulletins of the State Mining Bureau; also State Mining Bureau, Bulletin 27, "Quicksilver Resources of California," 1908, p. 10:

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Year	Flasks	Value	Average price per flask	Year	Flasks	Value	Average price per flask
1850	7,723	$768,052	$99 45	1890	22,926	$1,203,615	$52 50
1851	27,779	1,859,248	66 93	1891	22,904	1,036,406	45 25
1852	20,000	1,166,600	58 33	1892	27,993	1,139,595	40 71
1853	22,284	1,237,648	55 45	1893	30,164	1,108,527	36 75
1854	30,004	1,663,722	55 45	1894	30,416	934,000	30 70
1855	33,000	1,767,150	53 55	1895	36,104	1,337,131	37 04
1856	30,000	1,549,500	51 65	1896	30,765	1,075,449	34 96
1857	28,204	1,374,381	48 73	1897	26,691	993,445	37 28
1858	31,000	1,482,730	47 83	1898	31,092	1,188,626	38 23
1859	13,000	820,690	63 13	1899	29,454	1,405,045	47 70
1860	10,000	535,500	53 55	1900	26,317	1,182,786	44 94
1861	35,000	1,471,750	42 05	1901	26,720	1,285,014	48 46
1862	42,000	1,526,700	36 35	1902	29,552	1,276,524	43 20
1863	40,531	1,705,544	42 08	1903	32,094	1,335,954	42 25
1864	47,489	2,179,745	45 90	1904	*28,876	1,086,323	37 62
1865	53,000	2,432,700	45 90	1905	24,655	886,081	35 94
1866	46,550	2,473,202	53 13	1906	19,516	712,334	36 50
1867	47,000	2,157,300	45 90	1907	17,379	663,178	38 16
1868	47,728	2,190,715	45 90	1908	18,039	763,520	42 33
1869	33,811	1,551,925	45 90	1909	16,217	773,788	47 71
1870	30,077	1,725,818	57 38	1910	17,665	799,002	45 23
1871	31,686	1,999,387	63 10	1911	19,109	879,205	46 01
1872	31,621	2,084,773	65 93	1912	20,600	866,024	42 04
1873	27,642	2,220,482	80 33	1913	15,661	630,042	40 23
1874	27,756	2,919,376	105 18	1914	11,373	557,846	49 05
1875	50,250	4,228,538	84 15	1915	14,199	1,157,449	81 52
1876	75,074	3,303,256	44 00	1916	21,427	2,003,425	93 50
1877	79,396	2,961,471	37 30	1917	24,382	2,396,466	98 29
1878	63,880	2,101,652	32 90	1918	22,621	2,579,472	114 03
1879	73,684	2,194,674	29 85	1919	15,200	1,353,381	89 04
1880	59,926	1,857,706	31 00	1920	10,278	775,527	75 45
1881	60,851	1,815,185	29 83	1921	3,157	140,666	44 56
1882	52,732	1,488,624	28 23	1922	3,466	191,851	55 35
1883	46,725	1,343,344	28 75	1923	5,458	332,851	60 98
1884	31,913	973,347	30 50	1924	7,948	543,080	68 33
1885	32,073	986,245	30 75	1925	7,683	621,831	80 81
1886	29,981	1,064,326	35 50	1926	5,892	516,382	87 64
1887	33,760	1,430,749	42 38				
1888	33,250	1,413,125	42 50	Totals	2,219,431	$109,047,501	
1889	26,464	1,190,880	45 00				

*Flasks of 75 lbs. since June, 1904; of 76½ lbs. previously.

SILVER.

Bibliography: State Mineralogist Reports IV, VIII, XII–XXIII (inc.). Bulletins 67, 91. Min. & Sci. Press, March 1, 1919.

Except for the early-day production from the silver mines of the Calico district and the more recent production from those of the Randsburg area, both of which are in San Bernardino County, the recovery of silver in California has been largely as a by-product from its association with copper, lead, zinc, and gold ores.

The 1926 silver output of California totaled 2,022,460 fine ounces, valued at $1,262,015, compared with 3,054,416 fine ounces valued at $2,106,871 in 1925. Of the 1926 yield, $12,082 was from placers. The average price of domestic silver during 1926 was 62.4¢ per ounce in New York, as against 69.4¢ in 1925. The figures below are those of the U. S. Bureau of Mines, Department of Commerce (as explained under Gold).

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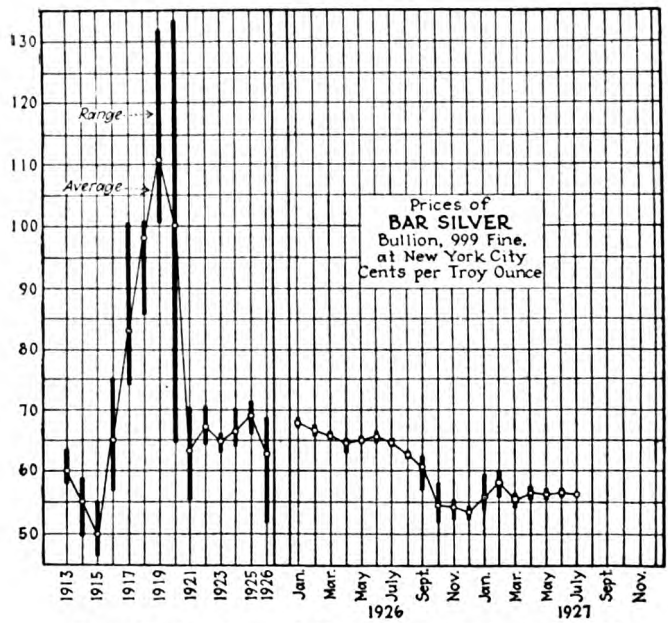

From Engineering and Mining Journal, Aug. 13, 1927.

The distribution of the 1926 silver yield, by counties, was as follows:

Silver Production, by Counties, 1926.

County	*Fine ounces*	*Value*
Amador	21,510	$13,422
Butte	4,803	2,997
Calaveras	9,983	6,229
Del Norte	6	4
El Dorado	756	472
Fresno	84	52
Humboldt	10	6
Imperial	31	19
Inyo	124,508	77,693
Kern	7,479	4,667
Lassen	1	1
Los Angeles	68,362	42,658
Madera	35	22
Mariposa	2,433	1,518
Modoc	5	3
Mono	194,557	121,404
Monterey	5	3
Napa	81,116	50,616
Nevada	48,101	30,015
Orange	1,550	967
Placer	554	346
Plumas	347,147	216,620
Riverside	5,024	3,135
Sacramento	2,607	1,627
San Bernardino	884,045	551,644
San Diego	545	340
Santa Cruz	1	1
Shasta	177,434	110,719
Sierra	4,669	2,913
Siskiyou	1,137	709
Stanislaus	659	411
Trinity	21,275	13,276
Tuolumne	1,793	1,119
Yuba	10,235	6,387
Totals	2,022,460	$1,262,015

The following paragraphs are quoted from the U. S. Bureau of Mines, Department of Commerce, Advance Chapter on Gold and Silver for

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1926, by courtesy of Mr. J. M. Hill, statistician in charge of the San Francisco branch office:

"The output of silver in California in 1926 was 2,022,460 ounces, valued at $1,262,015, a decrease of 34 per cent in quantity and 40 per cent in value as compared with 1925. Five counties yielded more than 100,000 ounces of silver each in 1926, namely, San Bernardino, with 884,045 ounces, a decrease of 1,102,110 ounces, largely from silver ore produced by the California Rand Silver (Inc.); Plumas County, with 347,147 ounces, a decrease of 76,850 ounces, largely from copper ores of the Engels and Walker mines; Shasta County, with 177,434 ounces, a decrease of 123,456 ounces, largely from copper and zinc ores; Mono County, with 194,557 ounces, an increase of 192,266 ounces; and Inyo County, with 124,508 ounces, a decrease of 45,180 ounces, most of which was from lead ore. The next largest silver production was 81,116 ounces from Napa County silver ores, followed by 68,362 ounces from Los Angeles County lead-zinc ores.

"The yield of silver from placer mines in 1926 was 19,362 ounces, an increase of 4 per cent as compared with 1925, and 0.96 per cent of the total silver output of the state. Of the 2,003,098 ounces of silver produced at lode mines in 1926 silver ore and tailings yielded 57 per cent (66 per cent in 1925), copper ore and tailings 20 per cent (23 per cent in 1925), lead ore 6 per cent (same in 1925), gold ore and tailings 5 per cent (3 per cent in 1925), and zinc ore 7 per cent and lead-zinc ore nearly 4 per cent.

"Silver production at each of 46 properties was in excess of 1000 ounces in 1926 as compared with 45 in 1925, and these mines yielded 98 per cent of the total silver produced in the state. At 31 properties the yield was between 1000 and 10,000 ounces (30 in 1925), at 10 between 10,000 and 100,000 (11 in 1925), at 4 between 100,000 and 300,000 (3 in 1925), and at 1 mine in excess of 800,000 ounces in 1926. No mine in California produced as much as 1,000,000 ounces of silver in 1926. The 10 largest silver producers in California in 1926, in order of output, were the California Rand Silver (Inc.), Mono Mining Co. of Nevada, Engels Copper Mining Co., Walker Mining Co., California Zinc Co., Palisades Mines Co., Santa Catalina Island Co., American Metals Co., Tecopa Consolidated Mining Co., and the Empire Mines Co."

Silver Production of California, by Years.

The amount and value of the silver production of California, and the average price, annually, since 1880 are given in the table following. In the table shown in the statistical bulletins previous to Bulletin 97 (for 1925), the values shown for 1880–1904 (inc.) were taken from the reports of the Director of the Mint, of which the figures for 1880–1896 (inc.) were based on 'coinage value' ($1.2929 per fine ounce). We have recalculated these to commercial value, using the price table of the U. S. Geological Survey (McCaskey, H. D., Gold and Silver, 1913: Mineral Resources of the U. S., Part I, p. 847). From 1905 to date, the figures are those of the U. S. Geological Survey and its successor, the U. S. Bureau of Mines:

Year	Fine oz.	Value	Average price per oz.	Year	Fine oz.	Value	Average price per oz.
1880							
1881	882,169	$1,014,494	$1 15	1904	1,441,259	$835,929	$0 58
1882	580,091	655,503	1 13	1905	1,076,174	650,009	61
1883	653,569	745,069	1 14	1906	1,220,641	817,830	68
1884	1,129,244	1,253,461	1 11	1907	1,138,856	751,646	66
1885	3,236,087	3,593,056	1 11	1908	1,647,278	873,057	53
1886	1,986,260	2,125,298	1 07	1909	2,098,253	1,091,092	52
1887	1,245,747	1,233,290	0 99	1910	1,840,085	993,646	54
1888	1,262,282	1,237,036	0 98	1911	1,270,445	673,336	53
1889	1,314,874	1,235,982	0 94	1912	1,300,136	799,584	615
1890	823,947	774,510	0 94	1913	1,378,399	832,553	604
1891	820,336	861,353	1 05	1914	1,471,859	813,958	553
1892	737,224	729,852	0 99	1915	1,678,756	851,129	507
1893	358,575	311,960	87	1916	2,564,354	1,687,345	658
1894	415,468	324,065	78	1917	1,775,431	1,462,955	824
1895	229,896	144,834	63	1918	1,427,711	1,427,711	1 00
1896	463,911	301,542	65	1919	1,107,189	1,240,051	1 12
1897	326,757	222,195	68	1920	1,706,327	1,859,896	1 09
1898	754,648	452,789	60	1921	3,629,223	3,629,223	1 00
1899	701,788	414,055	59	1922	3,100,065	3,100,065	1 00
1900	855,869	513,521	60	1923	3,559,443	2,918,743	82
1901	1,168,157	724,257	62	1924	3,555,133	2,381,952	67
1902	950,831	570,499	60	1925	3,054,416	2,119,765	694
1903	1,163,041	616,412	53	1926	2,022,460	1,262,015	624
	958,230	517,444	54				
				Totals	68,083,794	$53,645,947	

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TIN.

Bibliography: Reports XV, XVII, XVIII. Bulletins 67, 91.

Tin is not at present produced in California; but during 1891–1892, there was some output from a small deposit near Corona, in Riverside County, as tabulated below. Small quantities of stream tin have been found in some of the placer workings in northern California, but never in paying amounts.

Two occurrences have also been noted, in northern San Diego County. Crystals of cassiterite were found there, associated with blue tourmaline crystals, amblygonite and beryl. No commercial quantity has been developed, only small pockets have been taken out.

The principal sources of the world's supply of tin are the islands of Banka, Billiton and Singkep, Netherlands India (Dutch East Indies), followed by the Federated Malay States (Perak, Pahang, Negri Sembilan and Selangor). Bolivia, Siam, Cornwall, Transvaal, New South Wales, Queensland and Tasmania are also important sources. A measurable amount of the metal is also recovered by detinning scrap and old cans.

Total Output of Tin in California.

Year	*Pounds*	*Value*
1891	125,289	$27,564
1892	126,000	32,400
Totals	251,289	$59,964

TUNGSTEN.

Bibliography: Reports XV, XVII, XVIII, XXII. Bulletins 38, 67, 91, 95. U. S. G. S. Bull. 652. Proc. Colo. Sci. Soc. Vol. XI. South Dakota School of Mines, Bulletin No. 12. Eng. and Min. Jour.-Press, Vol. 113, pp. 666–669, Apr. 22, 1922.

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive), when the mines were shut down owing to low prices due to excess stocks following the war and to lack of tariff protection against foreign importations. Production was resumed on a small scale late in 1923, and is now at practically its pre-war average annual tonnage, though the 1926 figures are about 25 per cent less than those for 1925.

The material shipped in 1926 included both high-grade sorted ore and concentrates, coming from properties in Inyo and San Bernardino counties. A total of 402 tons of all grades was reported produced, yielding 441 tons recalculated to 60% WO_3, valued at a total of $316,560.

Prices during 1926 ranged from $10.54 to $11.64 per unit, duty paid, for Chinese wolframite, with domestic scheelite $10.25 to $11.00. Present prices are approximately the same.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of the California tungsten ore is scheelite (cal-

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cium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known,[1] and the output has in some years equaled or exceeded that of ferberite (iron tungstate) from Boulder County, Colorado. It is interesting in this connection to note that, in practically all other tungsten producing districts of the world, wolframite is the important constituent.

Imports of foreign tungsten ore and alloys into the United States during 1926 amounted to 3,441,975 pounds, valued at $871,294, compared with 3,089,589 pounds valued at $735,108 in 1925, and 10,362 long tons of ore valued at $11,409,237 in 1918, which ores were duty free up to September 22, 1922. Owing to lack of protection against the cheap coolie labor of Asiatic tungsten mines, and the low market prices, practically all of the tungsten mines in the United States were closed down from the middle of 1919 to the latter part of 1923. Quotations during 1922 ranged around $2.50 per unit, up to September. The Tariff Act of 1922 placed a duty on tungsten ore or concentrates of 45¢ per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys. Most of the imported ore is coming from China, with smaller amounts from Malaya and Bolivia.

Uses.

The metal, tungsten, is used mainly in the steel industry and in the manufacture of electrical appliances, including the well-known tungsten filament lamps. Because of its resistance to corrosion by acids, it is valuable in making certain forms of chemical apparatus. Its employment in tool-steel alloys permits the operation of cutting tools, such as in lathe work, at a speed and temperature at which carbon steel would lose its temper—hence the name 'high speed' steels for these tungsten alloys. As made in the United States, tungsten forms 13% to 20% of such steels. Some chromium, nickel, cobalt, or vanadium are sometimes also included. Tungsten compounds are used in the manufacture of colors. The indicated consumption is approximately 5000 tons of 60% concentrates per year, in the United States.

Tungsten is introduced into the molten steel charge, either as the powdered metal or as ferro-tungsten (containing 50%–85% tungsten). The specific gravity of the pure metal, 19.3–21.4, is exceeded only by platinum, 21.5; iridium, 22.4; and osmium, 22.5. Its melting point is 3267° C. (5913° F.), being higher than any other known metal. Though millions of tungsten filament lamps are now made, the wires are so fine that the metal they contain represents but a few tons of tungsten concentrates annually.

Total Tungsten Ore Production of California.

The annual amount and value of tungsten ores and concentrates produced in California since the inception of the industry is given herewith, with tonnages recalculated to 60% WO_3:

[1] U. S. G. S. Bull. 652, p. 32.

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Year	Tons at 60% WO_3	Value	Year	Tons at 60% WO_3	Value
1905	57	$18,800	1916	2,270	$4,571,521
1906	485	189,100	1917	2,466	3,079,013
1907	287	120,587	1918	1,982	2,832,222
1908	105	37,750	1919	214	219,316
1909	577	190,500	1920		
1910	457	208,245	1923	34	19,126
1911	387	127,706	1924	781	446,009
1912	572	206,000	1925	573	348,475
1913	559	234,673	1926	441	316,560
1914	420	180,575			
1915	962	1,005,467	Totals	13,629	$14,351,641

VANADIUM.

Bibliography: Report XV. Bulletins 67, 91. Proc. Colo. Sci. Soc., Vol. XI. U. S. Bur. of Mines, Bulletin 104.

No commercial production of vanadium has yet been made in California. Occurrences of this metal have been found at Camp Signal, near Goffs, in San Bernardino County, and two companies at one time did considerable development work in the endeavor to open up paying quantities. Each had a mill under construction in 1916, but apparently no commercial output was made. Ore carrying the mineral cuprodescloizite and reported as assaying 4% V_2O_5 was opened up. Some ore carrying lead vanadate has been developed in the 29 Palms, or Washington district, on the line between Riverside and San Bernardino counties, but no shipments reported.

The principal use of vanadium is as an alloy in steels, especially in tool steel, and in those varieties where resistance to repeated strains is required. Present New York quotations for vanadium ore are @ 55¢–60¢ per pound of contained V_2O_5 (carrying 12%–18% V_2O_5).

ZINC.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XX, XXII, XXIII. Bulletins 38, 67, 91.

Recoverable zinc in ores mined in California in 1926 amounted to 20,447,559 pounds valued at $1,533,568, compared with 11,546,602 pounds and $877,542 in 1925. The bulk of the 1926 product came from Shasta and Los Angeles (Santa Catalina Island) counties and was shipped in the form of concentrates to Belgium. A portion of the output is used locally in the manufacture of lithopone, and a small amount of oxide is also made. The world situation as regards zinc was particularly favorable in 1926 to the American producer, and promises to continue so.

The average price per pound quoted for the metal in 1926 was 7.5¢, as against 7.6¢ in 1925 and 6.5¢ in 1924.

The zinc ores of Shasta and Calaveras counties are associated with copper, while those of Inyo and San Bernardino are associated principally with lead-silver and zinc-silver ores.

The principal uses of zinc are for 'galvanizing' (plating on iron to prevent rust), for zinc oxide (used in rubber goods and paint), and for brass (an alloy of copper and zinc). These outlets for the metal take approximately 80% of the quantity produced. Of the remaining 20% a large portion is rolled into plates and sheets, and utilized in the

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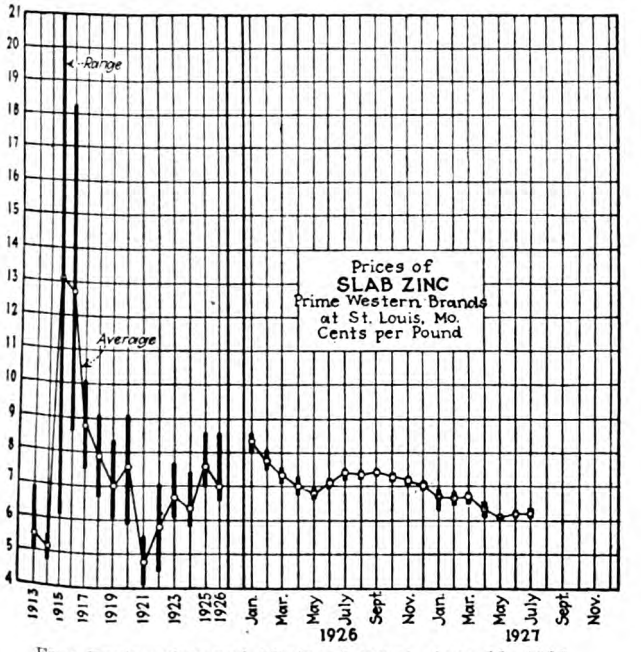
building industry for sheathing, roofing, leaders, and eaves-troughs. Zinc is particularly desirable and efficient for roofing and siding where corrosive gases are present, as at smelters, refineries and chemical plants.

Zinc Production of the United States.

The production of slab zinc[1] at reduction plants in the United States in 1926 amounted to 659,221 short tons valued at $98,883,000. This consisted of 611,991 tons of primary metal made from domestic ore, 6,431 tons of primary metal made from Mexican ore, and 40,799 tons of redistilled secondary metal. The 1926 production exceeded that of 1925 by 47,094 tons, or 8%.



From Engineering and Mining Journal, Aug. 13, 1927.

Total Zinc Production of California.

Total figures for zinc output of the state are as follows, commercial production dating back only to 1906:

Year	Pounds	Value	Year	Pounds	Value
1906					
1907					
1908	206,000	$12,566	1917	11,851,804	$1,209,190
1909	177,759	10,598	1918	5,565,561	506,466
1910	54,000	3,544	1919	1,384,192	101,016
1911			1920	1,188,009	96,220
1912			1921	846,184	42,309
1913	2,679,842	152,751	1922	3,034,430	172,963
1914	4,331,331	298,866	1923		
1915	1,157,947	64,845	1924	3,060,000	198,900
1916	399,641	20,381	1925	11,546,602	877,542
1917	13,043,411	1,617,383	1926	29,447,559	1,533,568
1918	15,950,565	2,137,375	Totals	96,927,897	$9,056,522

[1] U. S. Bureau of Mines Press Bull. Apr. 6, 1927.

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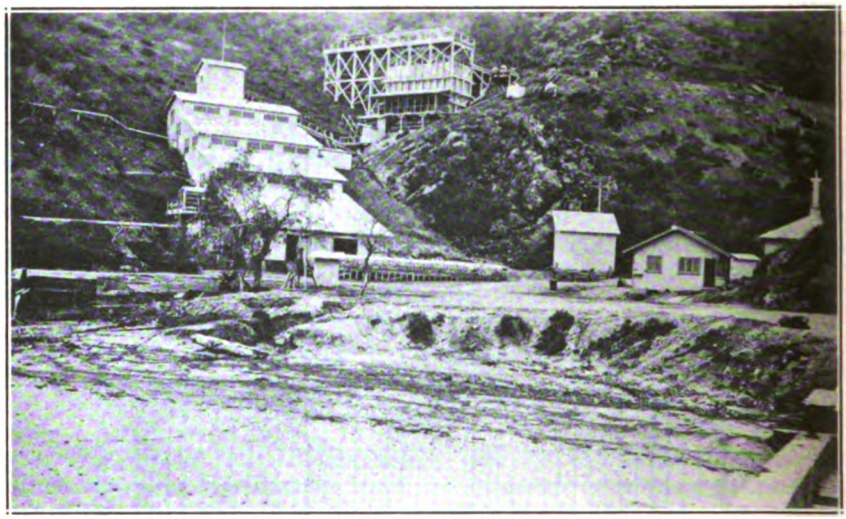

Storage bins and 100-ton flotation plant (zinc and lead), Santa Catalina Island, California.

CHAPTER FOUR.

STRUCTURAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the state. This branch of the mineral industry for 1926 was valued at $54,250,571 as compared with a total value of $53,526,995 for the year 1925, the increase being due to miscellaneous stone and cement in spite of important decreases in granite, brick, and magnesite.

Deposits of granite, marble and other building stones are distributed widely throughout this state, and transportation and other facilities are gradually being extended so that the growing demand may be met. The largest single item, cement, has had an interesting record of growth since the inception of the industry in California about 1891. Not until 1904 did the annual value of cement produced reach the million-dollar mark, following which it increased 500% in nine years; though from 1914 to 1918 there was a falling off common to all building materials. The 1926 output establishes a new high-level mark, in quantity, but the total value was a little short of the record figure of 1923.

Crushed rock production is yearly becoming more worthy of consideration, due to the strides taken in the use of concrete, as well as to activity in the building of good roads. Brick, with an average annual

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output for a number of years worth approximately $2,000,000, had difficulty in holding its own, due to the popularity of cement and concrete. In 1920, however, the sales increased to nearly double the previous record figure of the year 1907, and in 1923 showed advances to new figures, with a slight recession in 1924–1926. This item will, no doubt, continue to be an important one, and a market for fire and fancy brick of all kinds will unquestionably never be lacking.

All fifty-eight counties contributed to this structural total for 1926. There is not a county in the state which is not capable of some output of at least one of the materials under this classification.

The following summary shows the value of the structural materials produced in California during the years 1925–1926, with increases or decreases in each instance:

Substance	1925		1926		Increase+ Decrease—
	Amount	Value	Amount	Value	Value
Bituminous rock	*	*	3,863 tons	$21,577	* +
Brick and hollow building tile		$7,503,976		7,026,124	$477,852—
Cement	13,206,630 bbls.	25,043,335	13,797,173 bbls.	25,269,678	226,343+
Chromite	591 tons	10,912	395 tons	7,063	3,849—
Granite		1,853,859		655,332	1,198,527—
Lime	61,922 tons	685,528	63,568 tons	670,837	14,691—
Magnesite	64,623 tons	872,944	50,915 tons	587,642	285,302—
Marble	35,664 cu. ft.	116,105	34,806 cu. ft.	119,999	3,894+
Onyx and travertine	19,940 cu. ft.	16,120	15,090 cu. ft.	7,575	8,545—
Sandstone	14,704 cu. ft.	14,362	34,100 cu. ft.	17,500	3,138+
Slate				7,371	7,371+
Stone, miscellaneous		17,409,854		19,859,873	2,450,019+
Total values		$53,526,995		$54,250,571	
Net increase					$723,576+

*Under 'Unapportioned.'

ASPHALT.

Bibliography: State Mineralogist Reports VII, X, XII–XV (inc.), XVII, XVIII. Bulletins 16, 32 63, 67, 69, 91.

Asphalt was for a number of years accounted for in the statistical reports by the State Mining Bureau, because in the early days of the oil industry, considerable asphalt was produced from outcroppings of oil sand, and was a separate industry from the production of oil itself. However, at the present time most of the asphalt comes from the oil refineries, which produce a better and more uniform grade; hence, its value is not now included in the mineral total, as to do so would be in part a duplication of the crude petroleum figures. Such natural asphalt as is at present mined is in the form of bituminous sandstones, and is recorded under that designation.

BITUMINOUS ROCK.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XXI, XXII.

This material is essentially an uncemented sandstone which is saturated with and held together by a natural asphaltic constituent probably the residue from the evaporation of a crude petroleum deposit. Bituminous rock is still used to a limited extent for road dressing in those

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districts adjacent to available deposits, though the manufacture of asphalt at the oil refineries has almost entirely superseded the direct use of the native material. The present operators of the old City Street Improvement Company's quarry in Santa Cruz County advise that they are now putting on the market a material which can be laid cold. It will be especially applicable and valuable for patching jobs.

Shipments from quarries in Santa Barbara and Santa Cruz counties in 1926 totaled 3,863 tons of bituminous rock, valued at $21,577 f.o.b. rail-shipping point, being an increase over the 1925 shipments.

Bituminous Rock Production of California, by Years.

The following tabulation shows the total amount and value of bituminous rock quarried and sold in California, from the records compiled by the State Mining Bureau, annually since 1887:

Year	Tons	Value	Year	Tons	Value
1887	36,000	$160,000	1908	30,718	$109,818
1888	50,000	257,000	1909	34,123	116,436
1889	40,000	170,000	1910	87,547	165,711
1890	40,000	170,000	1911	75,125	117,279
1891	39,962	154,164	1912	44,073	87,467
1892	24,000	72,000	1913	37,541	78,479
1893	32,000	192,036	1914	66,119	166,618
1894	31,214	115,193	1915	17,789	61,468
1895	38,921	121,586	1916	19,449	66,561
1896	49,456	122,500	1917	5,590	18,580
1897	45,470	128,173	1918	2,561	9,067
1898	46,836	137,575	1919	4,614	18,537
1899	40,321	116,097	1920	5,450	27,825
1900	25,306	71,495	1921	8,298	43,192
1901	24,052	66,354	1922	4,624	13,570
1902	33,490	43,411	1923	2,945	11,780
1903	21,944	53,106	1924	6,040	14,922
1904	45,280	175,680	1925	2,681	10,724
1905	24,753	60,436	1926	3,863	21,577
1906	16,077	45,204			
1907	24,122	72,835	Totals	1,188,354	$3,664,456

BRICK AND HOLLOW TILE.

Bibliography: State Mineralogist Reports VIII, X, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 38, 99. Preliminary Report, No. 7. Cal. Jour. of Development, June, 1925, pp. 5–6.

Bricks of many varieties and in important quantities are annually produced in California, as might be expected in a state with such diversified and widespread mineral resources. The varieties include common, fire, pressed, glazed, enamel, fancy, vitrified, sand-lime, and others. Not only do the plants here supply practically all of our own requirements in these products, but considerable quantities are shipped to contiguous territory and certain products are shipped over a much wider radius. So far as possible, the different kinds have been segregated in the tabulation herewith accompanying.

We also include under this heading the various forms of hollow building 'tile' or blocks. The application of these tile to residence construction as well as to other structures is growing; though their total for 1926 shows a slight drop from the figures of 1925.

The aggregate value of all kinds of brick in 1926 shows a decrease of approximately 6% from that of 1925, to which each of the groups contributed.

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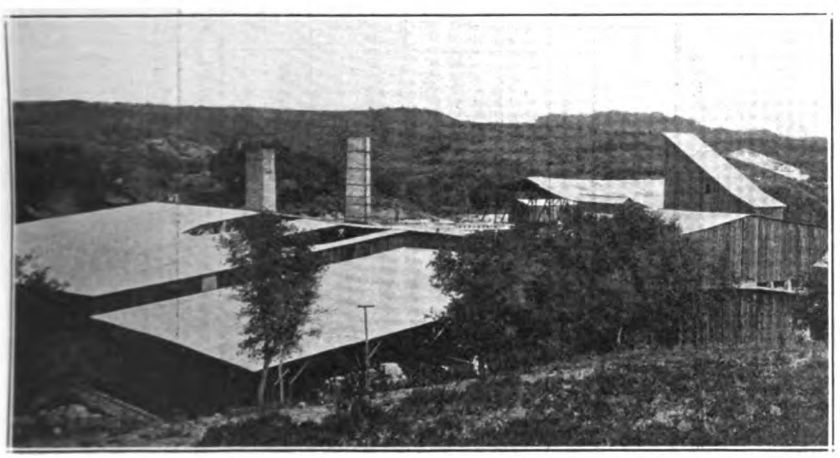
The detailed figures of brick and hollow tile production for 1926 by counties are given in the following tabulation. 'Production' in this case means *sales* of products of California manufacture; and 'value' is *net price* at the works, f. o. b. cars, trucks or boats.



Plant of Ione Brick Company, one mile east of Ione, Amador County.
Photo by C. A. Logan.

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Brick and Hollow Tile Production for 1926, by Counties.

County	Common		Fire		Glazed, pressed, fancy, vitrified, paving		Hollow building tile or blocks		Total value
	Amount	Value	Amount	Value	Amount	Value	Tons	Value	
Alameda	*		*		3,692	$178,222	35,330	$356,242	$534,464
Butte	273	$4,316							4,316
Fresno	5,117	76,731	*		*		*		76,731
Kern	4,591	55,140							55,140
Los Angeles	219,473	1,913,573	[a]7,079	$480,316	[b]11,774	560,178	21,471	192,408	3,146,475
Orange	6,272	72,489							72,489
Riverside	*		9,017	398,735	3,731	134,175	*		532,910
Sacramento	12,850	178,900	*		*		*		178,900
San Diego	10,291	124,424	*		*		*		124,424
San Joaquin	6,269	106,942	*				*		106,942
Santa Barbara	430	6,785					406	10,291	17,076
Santa Clara	18,222	197,782							197,782
Alameda, Amador, Contra Costa, Humboldt, Imperial, Marin, Merced, Riverside, San Luis Obispo, Tehama, Tulare*	44,876	494,515							494,515
Alameda, Amador, Contra Costa, Fresno, Merced, Placer, Sacramento, San Diego, San Joaquin*			13,285	705,002					705,002
Contra Costa, Fresno, Placer, Sacramento, San Diego*					10,806	466,010			466,010
Contra Costa, Fresno, Merced, Placer, Riverside, Sacramento, San Diego, San Joaquin, San Luis Obispo, Tulare*							33,125	312,948	312,948
Totals	328,664	$3,231,597	29,381	$1,584,053	30,003	$1,338,585	90,332	$871,889	$7,026,124

*Combined to conceal output of a single operator in each.
[a] Includes special silica brick.
[b] Includes Ferguson sewer liners.

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Brick and Hollow Tile Production of California, by Years.

Record of brick production in the state has been kept since 1893 by this Bureau, the figures for hollow building 'tile' or blocks being also included since 1914. The annual and total figures, for amount and value, are given in the following table:

Year	Brick, M	Hollow building blocks, tons	Value
1893	103,900	------	$801,750
1894	81,675	------	457,125
1895	131,772	------	672,360
1896	24,000	------	524,740
1897	97,468	------	563,240
1898	100,102	------	571,362
1899	125,950	------	754,730
1900	137,191	------	905,210
1901	130,766	------	860,488
1902	169,851	------	1,306,215
1903	214,403	------	1,999,546
1904	281,750	------	1,994,740
1905	286,618	------	2,273,786
1906	277,762	------	2,538,848
1907	362,167	------	3,438,951
1908	332,872	------	2,506,495
1909	333,846	------	3,059,929
1910	340,883	------	2,934,731
1911	327,474	------	2,638,121
1912	337,233	------	2,940,290
1913	358,754	------	2,915,350
1914	270,791	------	2,288,227
1915	180,538	------	1,678,756
1916	206,960	------	2,096,570
1917	192,269	29,348	2,532,721
1918	136,374	34,818	2,363,481
1919	156,328	36,026	3,087,067
1920	245,842	99,208	5,704,393
1921	238,022	67,100	5,570,875
1922	374,853	105,909	7,994,991
1923	397,754	122,534	9,738,082
1924	456,716	114,469	9,137,908
1925	361,094	105,491	7,503,976
1926	388,048	90,332	7,026,124
Totals	8,162,026	805,235	$103,381,178

CEMENT.

Bibliography: State Mineralogist Reports VIII, IX, XII, XIV, XV, XVII, XVIII, XXI–XXIII, Bulletin 38.

Cement is the most important single structural material in the mineral output of California. During 1926 there was produced a total of 13,797,173 barrels, valued at $25,269,678, f. o. b. plant, being an increase of over half a million barrels in quantity, but only slightly in total value owing to a small drop in prices. The 1925 output was 13,206,630 barrels valued at $25,043,335, or an average of $1.90 per barrel. The 1926 average was $1.84 per barrel.

The 1926 production came from eleven operating plants in nine counties, and employing a total of 3047 men. The three plants in San Bernardino County made a total of 5,135,840 barrels, valued at $9,273,627, the balance of the state's product coming from a single plant in each of the following counties: Calaveras, Contra Costa, Kern, Riverside, San Benito, San Mateo, Santa Cruz, and Solano. The new plant of the Calaveras Cement Company near San Andreas, Calaveras County, began operation and commercial shipments in 1926. Recent press notices record the consolidation of the Pacific Portland Cement Corporation operating cement plants in San Mateo and Solano counties

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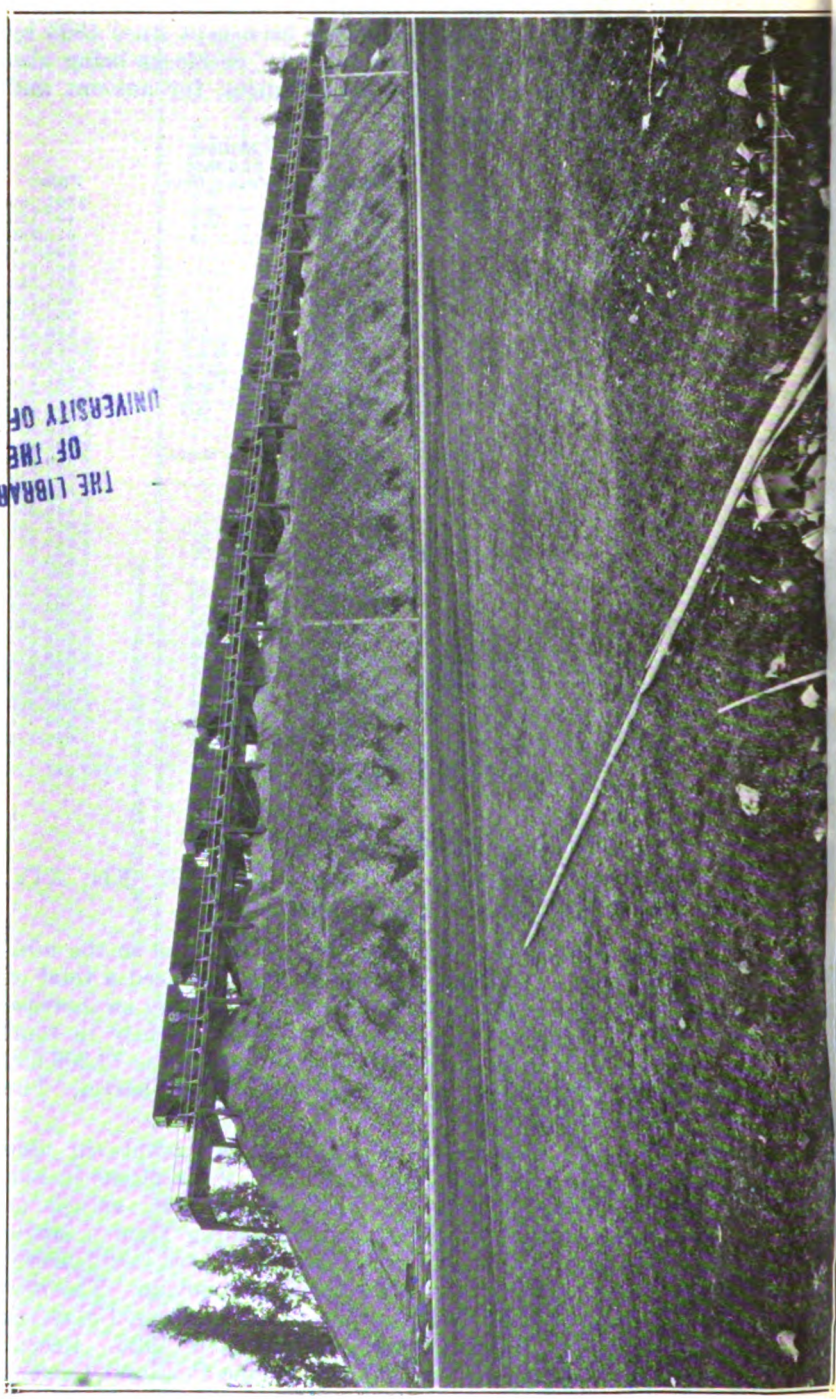

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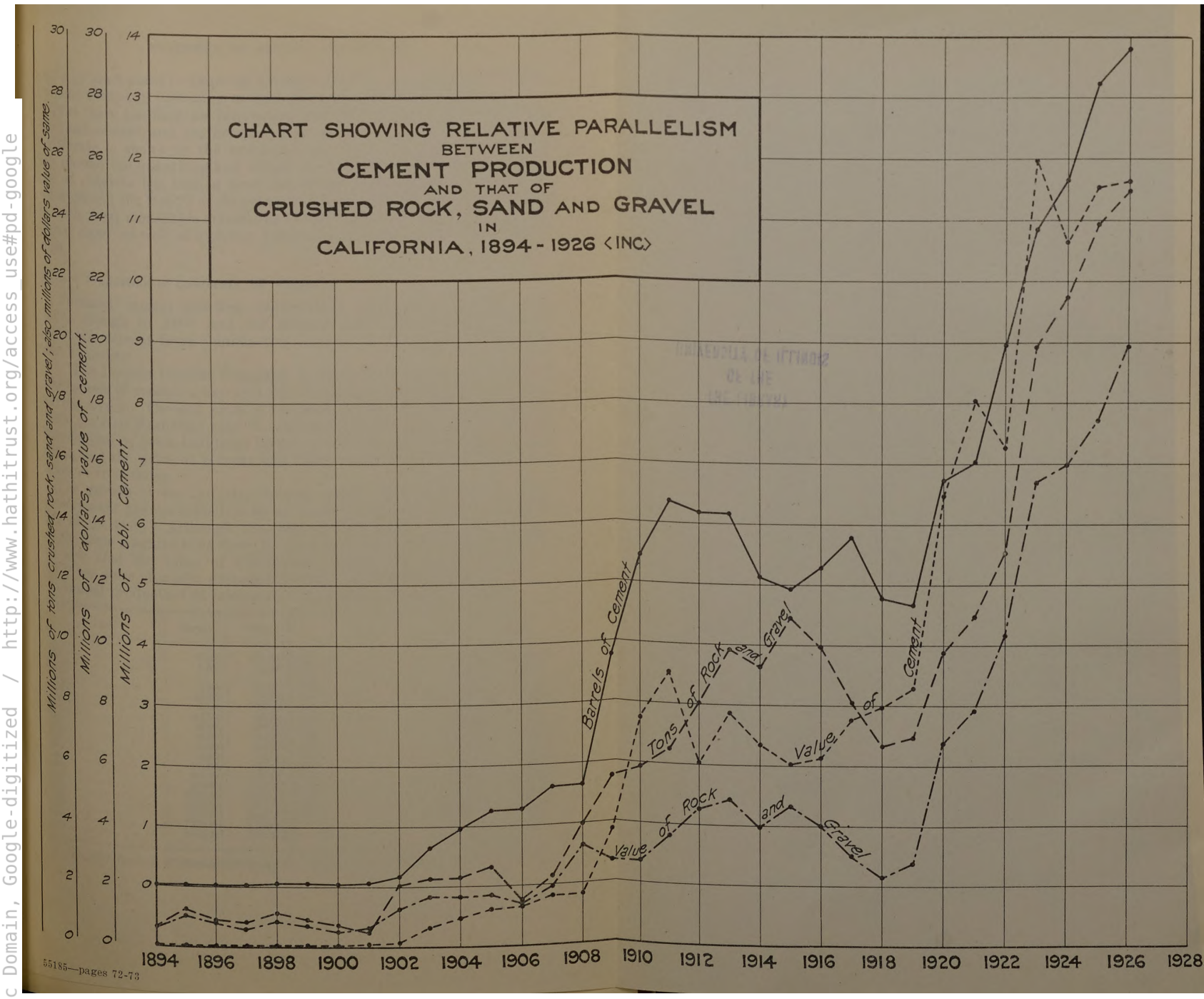

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and a gypsum plant in Imperial County, with the Old Mission Portland Cement Company operating at San Juan, San Benito County.

That there has been an interesting parallelism in the growth of the portland cement and the crushed rock, sand and gravel industries in California is shown in the accompanying chart, on which the writer has plotted the quantities and values of each by years since 1893. The use of concrete has been a most important development in structural work during the last 20 or 30 years, and has made possible the building of such great monolithic structures as our irrigation and hydroelectric-power dams, as well as highway pavements and skyscraper office buildings.

Cement Production of California, by Years.

'Portland' cement was first commercially produced in California in 1891; though in 1860 and for several years following, a natural hydraulic cement from Benicia was utilized in building operations in San Francisco.

[1] "The Benicia Cement Company in 1859–60 was turning out 50 to 100 barrels of cement a day and San Francisco was using about 12,000 barrels a year. The mill price of the product was then $4 a barrel. By 1865, the San Francisco rate of consumption had increased to 100,000 barrels yearly, brick buildings largely taking the place of frame structures, and the price of cement had fallen to $2.50 a barrel, about the same as it is today."

The growth of the industry became rapid after 1902; since which time cement has continued to be an important factor in the industrial life of the state. Although the total cement figures, to date, are not of the same magnitude as those for gold and petroleum, it is interesting to note that the value of California's cement yield beginning with 1920 has since annually exceeded the value of her gold output.

Annual production of cement in California has been as follows:

Year	Barrels	Value	Year	Barrels	Value
1881					
1882	5,000	$15,000	1910	5,453,193	$7,485,715
1883	5,000	15,000	1911	6,371,369	9,085,625
1884			1912	6,198,634	6,074,661
1885	8,000	21,600	1913	6,167,806	7,743,024
1886	16,383	32,556	1914	5,109,218	6,558,148
1887	9,500	28,250	1915	4,918,275	6,044,950
1888	18,000	66,000	1916	5,299,507	6,210,293
1889	50,000	150,000	1917	5,790,734	7,544,282
1890	60,000	180,000	1918	4,772,921	7,969,909
1891	52,000	121,000	1919	4,615,289	8,591,990
1892	71,800	159,812	1920	6,709,160	14,962,945
1893	171,000	423,600	1921	7,404,221	18,072,120
1894	510,868	968,727	1922	8,962,135	16,524,056
1895	969,538	1,539,807	1923	10,825,405	25,999,203
1896	1,265,553	1,791,916	1924	11,655,131	23,225,850
1897	1,286,000	1,941,250	1925	13,206,630	25,043,335
1898	1,613,563	2,585,577	1926	13,797,173	25,269,678
1899	1,629,615	2,359,692			
1900	3,779,205	4,969,437	Totals	138,937,826	$239,775,028

[1] Monthly Review, of Mercantile Trust Co. of Cal., Vol. XIII, No. 3, p. 55, Mar. 1924.

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CHROMITE.

Bibliography: State Mineralogist Reports IV, XII, XIII, XIV, XV, XVII, XVIII, XXI–XXIII. Bulletins 38, 76, 91. Preliminary Report 3. U. S. G. S., Bull. 430. Min. & Sci. Press, Vol. 114, p. 552.

Chromic iron ore, or chromite, to the amount of 395 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $7,063 f.o.b. shipping point, was sold in California during the year 1926. This was largely of ore that had been mined during the World War period but not then sold. It is hoped that the development of the steel industry and the resumption of copper smelting on the Pacific Coast may create some demand for California's chromite, but the outlook for the immediate future is not encouraging.

The political and commercial control of chromite now rests largely with England, through the ownership and sales contracts exercised by the Chrome Company (Ltd.), of London. That company controls both the Rhodesian and the New Caledonian output.

Occurrence.

Until 1916, when some shipments were made from Oregon and smaller amounts from Maryland, Wyoming and Washington, practically our only domestic production of chromite for many years came from California. From 1830 to 1870 the deposits in Maryland supplied the world's consumption.

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the state's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks. For the most part, so far as developments have yet shown, the lenses have proved to be small, relatively few of them yielding over 100 tons apiece. A notable exception to this was the deposit on Little Castle Creek, near Dunsmuir, from which upwards of 15,000 tons was shipped before it was exhausted. Deposits worked in Del Norte County during 1918 promise well for a large tonnage. On the whole the orebodies in the northwestern corner of the state appear to average larger in size than the chromite lenses in other parts of California.

Concentration became an accomplished fact in several localities, thus utilizing some of the disseminated and lower-grade orebodies which have been found. In fact, an important part of the 1918–1920 production of California came from that source.

Imports.

Importations of foreign chromite, duty free, mainly from Rhodesia, New Caledonia, and India, totaled 214,944 long tons in 1926, valued at $1,711,347, compared with 149,739 long tons and $1,207,420 in 1925.

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Uses.

The major consumption of chromite ore is for use as a refractory lining in smelting furnaces for steel and copper. A smaller portion is used in the preparation of ferrochrome for chrome-steel alloys, and of chromium chemicals. It is stated that during the last three years, the sales of chromite brick and chromite cement have increased 500%, because of their replacing magnesite which is more expensive.

Total Chromite Production of California.

Production of chromite in California began, apparently, about 1874, principally in San Luis Obispo County. There was considerable activity from 1880 to 1883, inclusive, and a total of 23,238 long tons (or 26,028 short tons), valued at $329,924 was shipped from that county up to the beginning of 1887. Some ore also was shipped from the Tyson properties in Del Norte County. The tabulation herewith shows the output of chromite in California, annually, including the earliest figures so far as they are available. The figures from 1887 to date are from the records of the State Mining Bureau:

Year	Tons	Value	Year	Tons	Value
1874–1876 (San Luis Obispo County)			1907	302	$6,040
1887	26,028	$329,924	1908	350	6,195
1888	3,000	40,000	1909	436	5,309
1889	1,500	20,000	1910	749	9,707
1890	2,000	30,000	1911	935	14,197
1891	3,599	53,985	1912	1,270	11,260
1892	1,372	20,580	1913	1,180	12,700
1893	1,500	22,500	1914	1,517	9,434
1894	3,319	49,785	1915	3,725	38,044
1895	3,680	39,980	1916	48,943	717,244
1896	1,740	16,795	1917	52,379	1,130,298
1897	786	7,775	1918	73,955	3,649,497
1898			1919	*4,314	97,164
1899			1920	1,770	43,031
1900			1921	347	6,870
1901	140	1,400	1922	379	6,334
1902	130	1,950	1923	84	1,658
1903	315	4,725	1924	350	6,700
1904	150	2,250	1925	191	3,712
1905	123	1,845	1926	393	7,063
1906	40	600			
	317	2,859	Totals	243,310	$6,429,960

*Recalculated to 45% Cr_2O_3, beginning with 1919.

GRANITE.

Bibliography: State Mineralogist Reports, X, XII–XXI (inc.). Bulletin 38.

The value of the granite output of California for 1926 receded somewhat from that of 1925 which was the highest recorded for any year since the compilation of these figures by the State Mining Bureau, due mainly to completion of the contract for the construction of the new Los Angeles County Building. Stone for 'monumental' and decorative purposes maintains nearly the same level in both quantity and total value. The net result was a decrease in total value of the several groups from $1,853,859 to $655,332. We have included under this heading some rhyolite and tuff utilized for dimension building stone, as we have no other dimension-stone grouping for statistical purposes in this report except marble and sandstone.

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Crushed rock, rubble, and paving blocks derived from granite quarries are given under the heading of 'Miscellaneous Stone.'

So far as possible, granite production has been segregated in the table herewith into the various uses to which the product was put. It will be noted, however, that a portion of the output has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

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Granite Production by Counties, for 1926.

County	Building stone		Monumental		Curbing		Unclassified		Total value
	Cubic feet	Value	Cubic feet	Value	Linear feet	Value	Cubic feet	Value	
Fresno			17,880	$78,624					$78,624
Placer	225	$1,800	2,212	2,817			3,655	$7,352	11,969
Sacramento	6,250	7,812							7,812
San Diego			16,273	45,327					45,327
Inyo[a], Los Angeles[a], Madera, Plumas, Riverside, Tulare*	52,967	71,420							71,420
Madera, Nevada, Plumas, Riverside, Tulare, Tuolumne*			20,334	87,919					87,919
Madera, Nevada, Tuolumne*					3,500	$4,800			4,800
Madera, Tuolumne*							258,965	347,461	347,461
Totals	59,442	$81,032	56,699	$214,687	3,500	$4,800	262,620	$354,813	$655,332

*Combined to conceal output of a single operator in each.
[a]Tuff used for building stone.

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Granite Production of California, by Years.

The value of granite produced, annually, since 1887, has been as follows:

Year	Value	Year	Value
1887	$150,000	1908	$512,923
1888	57,000	1909	376,834
1889	1,329,018	1910	417,898
1890	1,200,000	1911	355,742
1891	1,300,000	1912	362,975
1892	1,000,000	1913	981,277
1893	531,322	1914	628,786
1894	228,816	1915	227,928
1895	224,329	1916	535,339
1896	201,004	1917	221,997
1897	188,024	1918	139,861
1898	147,732	1919	220,743
1899	141,070	1920	495,732
1900	295,772	1921	725,901
1901	519,285	1922	676,643
1902	255,239	1923	760,081
1903	678,670	1924	1,211,046
1904	467,472	1925	1,853,859
1905	353,837	1926	655,332
1906	344,083		
1907	373,376	Total value	$21,346,946

LIME.

Bibliography: Reports XIV, XV, XVII, XVIII. Bulletin 38.

Lime to the amount of 63,568 tons, valued at $670,837, was produced by nine plants in seven counties during 1926, as compared with 61,922 tons, valued at $685,528, in 1925. There were two plants each in San Bernardino and Santa Cruz counties, and one each in El Dorado, Kern, Shasta, Tulare, and Tuolumne.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

Lime Production of California, by Years.

The following tabulation gives the amounts and value of lime produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. The figures for quantity have been recalculated from 'barrels' to 'tons' for the years 1894–1922 (inc.):

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Year	Tons	Value	Year	Tons	Value
1884	37,350	$318,700	1912	52,212	$464,440
1885	39,776	386,094	1913	61,344	528,547
1886	30,275	261,505	1914	43,996	378,663
1887	28,780	252,900	1915	35,653	286,304
1888	29,786	254,010	1916	49,364	390,475
1889	29,985	314,575	1917	50,073	311,380
1890	31,252	283,699	1918	43,684	461,315
1891	31,738	334,688	1919	42,070	552,043
1892	44,866	369,616	1920	46,314	557,232
1893	49,659	418,280	1921	46,353	610 619
1894	57,945	571,749	1922	57,875	671,747
1895	61,700	555,322	1923	70,894	788,834
1896	68,927	763,060	1924	62,029	703,355
1897	68,422	756,376	1925	61,922	685,528
1898	39,639	379,243	1926	63,568	670,837
1899	52,075	577,824			
1910	47,951	477,683	Totals	1,580,436	$15,727,631
1911	42,959	390,988			

MAGNESITE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXIII. Bulletins 38, 79, 91. U. S. Geol. Surv. Bulletins 355, 540; Min. Res. 1913, Pt. II, pp. 450–453. Min. & Sci. Press, Vol. 114, p. 237. "Magnesite"—Hearings before the Comm. on Ways and Means, House of Repr., on H. R. 5218, June 16, 17, and July 17, 1919. Eng. Soc. W. Penn., Proc. 1913, Vol. 29, pp. 305–388, 418–444. Eng. & Min. Jour.-Press, Vol. 114, July 29, and Dec. 2, 1922. U. S. Tariff Comm., "Crude and Caustic Calcined Magnesite. A Preliminary Statement of Information," May 19, 1926.

The production of magnesite in California during 1926 amounted to a total of 50,915 tons of crude ore, valued at $587,642. Only a small part of it was sold 'crude,' however, as it is practically all shipped in the calcined form. The reports at hand show a total of 21,950 tons shipped calcined, of which over 3,500 tons was dead-burned and sold for refractory purposes, the balance going to the plastic trade. From 2 to 2½ tons of crude material are mined to make one ton of calcined. The 1926 output is a decrease both in quantity and value from the 1925 figures of 64,623 tons crude valued at $872,944. The average of the values reported for 1926 is $11.60 per ton compared with $13.50 in 1925.

The more important producing properties in 1925 were: Maltby No. 1 Western Magnesite Development Co., operated under lease by C. S. Maltby) on Red Mountain, Santa Clara County; and the Sierra Magnesite Company's group near Porterville, Tulare County; followed in order by the Sampson Peak Mine (Maltby No. 3), San Benito County, Gray Eagle Mine in Tuolumne County, and California Magnesia Company (old Harker Mine) at Porterville. A small amount was also contributed from Stanislaus County.

A preliminary press bulletin by Mr. J. M. Hill of the U. S. Bureau of Mines (Mar. 23, 1927) shows: Imports of magnesite in 1926 were 608 tons crude, valued at $6,555, most of which came from Italy; 14,830 tons of caustic calcined, valued at $330,131, over half of which came from India, and 77,108 tons of dead-burned, valued at $1,128,823, practically all of which was from Italy. This was the equivalent of a total of 196,318 tons of crude ore.

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Occurrence.

Magnesite is a natural carbonate of magnesium, and when pure contains 52.4% CO_2 (carbon dioxide) and 47.6% MgO (magnesia). It has a hardness of 3.5 to 4.5, and specific gravity of 3 to 3.12. It is both harder and heavier than calcite (calcium carbonate), and also contains a higher percentage of CO_2 as calcite has but 44%.

Most of the Californian magnesite is comparatively pure, and is ordinarily a beautiful, white, fine-grained rock with a conchoidal fracture resembling a break in porcelain. The Grecian magnesite is largely of this character; but the Austrian varieties usually contain iron, so that they become brown after calcining. The Washington magnesite resembles dolomite and some crystalline limestones in physical appearance. Its color varies through light to dark gray, and pink.

In California the known deposits are mostly in the metamorphic rocks of the Coast Ranges and the Sierra Nevada, being associated with serpentine areas. The notable exceptions are the sedimentary deposits, at Bissell in Kern County and at Afton in San Bernardino County. Several thousand tons have been shipped from the Bissell deposit; and small shipments have been made from the Afton property.

The Washington deposits are associated with extensive strata of dolomitic limestone. The magnesite there appears to contain more iron than most of the California mineral, which makes it desirable for the steel operators. However, recent experience has proved that several California localities have sufficient iron in their magnesite to be serviceable in the steel furnaces.

Uses.

The principal uses include: Refractory linings for basic open-hearth steel furnaces, copper reverberatories and converters, bullion and other metallurgical furnaces; in the manufacture of paper from wood pulp; and in structural work, for exterior stucco, for flooring, wainscoting, tiling, sanitary kitchen and hospital finishing, etc. In connection with building work it has proved particularly efficient as a flooring for steel railroad coaches, on account of having greater elasticity and resilience than 'Portland' cement. For refractory purposes the magnesite is 'dead-burned'—*i. e.*, all or practically all of the CO_2 is expelled from it. For cement purposes it is left 'caustic'—*i. e.*, from 2% to 10% of CO_2 is retained. When dry caustic magnesite is mixed with a solution of magnesium chloride ($MgCl_2$) in proper proportions, a very strong cement is produced, known as oxychloride or Sorel cement. It is applied in a plastic form, which sets in a few hours, as a tough, seamless surface. It has also a very strong bonding power, and will hold firmly to wood, metal, or concrete as a base. It may be finished with a very smooth, even surface, which will take a good wax or oil polish. As ordinarily mixed there is added a certain proportion of wood flour, cork, asbestos, or other filler, thereby adding to the elastic properties of the finished product. Its surface is described as 'warm' and 'quiet' as a result of the elastic and nonconducting character of the composite material. The cement is frequently colored by the addition of some mineral pigment to the materials before mixing as cement.

For refractory purposes the calcined magnesite is largely made up into bricks similar to fire-brick for furnace linings. It is also used

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unconsolidated, as 'grain' magnesite. For such, an iron content is desirable, as it allows of a slight sintering in forming the brick. Dead-burned, pure magnesia can not be sintered except at very high temperatures; and it has little or no plasticity, so that it is hard to handle. Its plasticity is said to be improved by using with it some partly calcined or caustic magnesite. Heavy pressure will bind the material sufficiently to allow it to be sintered.

A coating of crushed magnesite is laid on hearths used for heating steel stock for rolling, to prevent the scale formed from attacking the fire-brick of the hearth.

Before the World War, practically all of the domestic output of caustic magnesite was used in the manufacture of pulp and paper. For this purpose calcined dolomite is now used. The use of dolomite instead of magnesite by paper manufacturers began during the war when the price of magnesite was very high. Dolomite was found to be a good substitute for magnesite in the bisulphite process of paper making and so its use has continued.

Imports and Domestic Production.

Reports of the U. S. Bureau of Foreign and Domestic Commerce show imports of calcined magnesite to have been 172,591 long tons in 1913; 144,747 in 1914, and 63,347 in 1915; most of it coming from Austria-Hungary (now under Italy) and some from Greece, that from the former being refractory dead-burned and from the latter caustic. For the same years the production of crude (from 2 to 2½ tons of crude ore required to yield one ton of the calcined) magnesite in California the sole producer of those years, in the United States) was: 9632 short tons, 11,438 tons, 30,721 tons, respectively. For 1916 California's output leaped to 154,052 tons of crude and to 209,648 tons in 1917, but following which it dropped considerably on account of resumption of foreign importations, which totaled 52,483 long tons in 1921, valued at $776,384, being then admitted duty free. Shipments from Washington were begun late in 1916; and during the following three years assumed important proportions.

The Tariff Act of 1922, which became effective September 22d, of that year, placed the following import duties on magnesite: Crude magnesite 5/16¢ per lb., caustic-calcined magnesite 5/8¢ per lb.; dead-burned and grain magnesite, not suitable for manufacture into oxychloride cements, 23/40¢ per lb.; magnesite brick, 3/4¢ per lb. and 10% ad valorem. The figures of imports for 1926 as published by the U. S. Bureau of Foreign and Domestic Commerce, show a total of 92,546 short tons of calcined ore, valued at $1,465,509, as compared with 69,117 tons and $1,172,644 in 1925.

Total Magnesite Production of California.

The first commercial production of magnesite in California was made in the latter part of 1886 from the Cedar Mountain district,[1] southeast of Livermore, Alameda County. Shipments amounting to 'several

[1] See U. S. Geol. Surv.; Mineral Resources of U. S., 1886, pp. 6 and 696.

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tons' or 'several carloads' were sent by rail to New York; but there is apparently no exact record of the amount for that first year. The statistical records of the State Mining Bureau began with the year 1887, and the table herewith shows the figures for amount and value, annually, from that time. Shipments of magnesite from Napa County began in 1891 from the Snowflake Mine; from the Red Mountain deposits in Santa Clara County, in 1899; and from Tulare County in 1900.

Year	Tons	Value	Year	Tons	Value
1887	600	$9,000	1909	7,942	$62,588
1888	600	9,000	1910	16,570	113,857
1889	600	9,000	1911	8,858	67,430
1890	600	9,000	1912	10,512	105,120
1891	1,500	15,000	1913	9,632	77,056
1892	1,500	15,000	1914	11,438	114,380
1893	1,093	10,930	1915	30,271	283,461
1894	1,410	10,240	1916	154,052	1,311,893
1895	2,200	17,000	1917	209,648	1,976,227
1896	1,500	11,000	1918	83,974	803,492
1897	1,143	13,671	1919	44,696	452,094
1898	1,263	19,075	1920	83,695	1,033,491
1899	1,280	18,480	1921	47,837	511,102
1900	2,252	19,333	1922	55,637	594,665
1901	4,726	43,057	1923	73,963	946,643
1902	2,830	20,655	1924	67,236	900,183
1903	1,361	20,515	1925	64,623	872,944
1904	2,850	9,298	1926	50,915	587,642
1905	3,933	16,221			
1906	4,032	40,320	Totals	1,086,239	$11,288,635
1907	6,105	57,720			
1908	10,582	80,822			

MARBLE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII–XXII (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 106.

Marble is widely distributed in California, and in a considerable variety of colors and grain. The 1926 figures show a slight decrease in quantity and increase in value from those of 1925, being 34,806 cu. ft., worth $119,999.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

Marble Production of California, by Years.

Data on annual production since 1887, as compiled by the State Mining Bureau, follows. Previous to 1894 no records of amounts were preserved.

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Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$5,000	1908	18,653	$47,665
1888		5,000	1909	79,600	238,100
1889		87,030	1910	18,960	50,200
1890		80,000	1911	20,201	54,103
1891		100,000	1912	27,820	74,120
1892		115,000	1913	41,654	113,282
1893		40,000	1914	25,436	48,832
1894	38,441	98,326	1915	22,186	41,518
1895	14,864	56,566	1916	25,954	50,280
1896	7,889	32,415	1917	24,755	62,950
1897	4,102	7,280	1918	[a]17,428	49,898
1898	8,050	23,594	1919	25,020	74,482
1899	9,682	10,550	1920	[b]29,531	92,899
1900	4,103	5,891	1921	30,232	98,395
1901	2,945	4,630	1922	38,321	127,792
1902	19,305	37,616	1923	28,015	124,919
1903	84,624	97,354	1924	[b]61,579	140,253
1904	55,401	94,208	1925	35,664	116,105
1905	73,303	129,450	1926	34,806	119,999
1906	31,400	75,800			
1907	37,512	118,066	Total value		$2,949,868

[a]Includes onyx and serpentine.
[b]Includes onyx.

ONYX and TRAVERTINE.

Bibliography: State Mineralogist Reports XII–XV (inc.), XVII, XVIII. Bulletin 38.

Onyx and travertine are known to exist in a number of places in California, but there has been only a small and irregular production since the year 1896. In 1926 there were shipments from Solano, Riverside, and Mono counties totaling 15,090 cu. ft., valued at $7,575. The Solano County material was mainly used for terrazzo.

Onyx Production of California, by Years.

Production by years has been as follows:

Year	Value	Year	Value
1887	$900	1918	*
1888	900	1919	
1889	900	1920	*
1890	1,500	1921	1,294
1891	2,400	1922	3,320
1892	1,800	1923	2,510
1893	27,000	1924	*
1894	20,000	1925	16,120
1895	12,000	1926	7,575
1896	24,000		
		Total value	$122,219

*See under Marble.

SANDSTONE.

Bibliography: State Mineralogist Reports XII–XV, XVII, XVIII, XXI. Bulletin 38. U. S. Bur. of M., Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1926 a total of 34,100 cu. ft., valued at $17,500, was quarried in four counties, Colusa, Los Angeles, Monte-

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rey, and Siskiyou; compared with 14,704 cu. ft. and $14,362 in 1925. The material reported from Monterey County is in reality an indurated shale of the Monterey series, of a cream-color and utilized as a building stone.

Sandstone Production of California, by Years.

Amount and value, so far as contained in the records of this Bureau, are presented herewith, with total value from 1887 to date:

Year	Cubic feet	Value	Year	Cubic feet	Value
1887		$175,000	1908	93,301	$55,151
1888		150,000	1909	79,240	37,032
1889		175,598	1910	165,971	80,443
1890		100,000	1911	255,313	127,314
1891		100,000	1912	66,487	22,574
1892		50,000	1913	62,227	27,870
1893		26,314	1914	111,691	45,322
1894		113,592	1915	63,350	8,438
1895		35,373	1916	17,270	10,271
1896		28,379	1917	31,090	7,074
1897		24,086	1918	900	400
1898		46,384	1919	5,400	3,720
1899	56,261	103,384	1920	10,500	2,300
1900	378,468	251,140	1921	10,150	2,112
1901	266,741	192,132	1922	900	1,100
1902	212,123	142,596	1923	7,000	13,000
1903	353,002	585,309	1924	6,700	3,600
1904	363,487	567,181	1925	14,704	14,362
1905	302,813	483,268	1926	34,100	17,500
1906	182,076	164,068			
1907	159,573	148,148	Total value		$4,144,445

SERPENTINE.

Bibliography: State Mineralogist Report XV. Bulletin 38.

Serpentine has not been produced in California to a very large extent at any time. A single deposit, that on Santa Catalina Island, has yielded the principal output to date. Some material was shipped from there in 1917 and 1918, being the only output recorded since 1907. It was used for decorative building purposes and for electrical switchboards. As there was but a single operator, the figures were combined with those of marble output for those years.

Serpentine Production of California, by Years.

The following table shows the amount and value of serpentine from 1895 as recorded by this Bureau:

Year	Cubic feet	Value	Year	Cubic feet	Value
1895	4,000	$4,000	1904	200	$2,310
1896	1,500	6,000	1905		
1897	2,500	2,500	1906	847	1,694
1898	750	3,000	1907	1,000	3,000
1899	500	2,000	1917	[a]	[a]
1900	350	2,000	1918	[b]	[b]
1901	89	890	1919		
1902	512	5,065			
1903	99	800	Totals	12,347	$33,259

[a] Under 'Unapportioned.'
[b] See under Marble.

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SLATE.

Bibliography: State Mineralogist Reports XV, XVIII. Bulletin 38. U. S. Geol. Surv., Bull. 586. U. S. Bur. of Mines, Bull. 218.

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

'Slate' is a term applied to a fine-grained rock that has a more or less perfect cleavage, permitting it to be readily split into thin, smooth sheets. Varieties differ widely in color and have a considerable range in chemical and mineralogical composition. Excepting certain rare slates of igneous origin (of which the green slate of the Eureka quarry, El Dorado County, California, is an example) formed from volcanic ash or igneous dikes, slates have originated from sedimentary deposits consisting largely of clay. By consolidation, and the pressure of superimposed materials, clays become bedded deposits of shale. By further consolidation under intense pressure and high temperature incident to mountain-building forces, shales are metamorphosed to slates. The principal mineral constituents are mica, quartz, and chlorite, with smaller varying amounts of hematite, rutile, kaolin, graphite, feldspar, tourmaline, calcite, and others.

The color of slate is of economic importance. The common colors are gray, bluish gray, and black, though reds and various shades of green are occasionally found.

The permanency of slate for roofing is well known. It is stated that there are slate roofs in Pennsylvania and Maryland over 100 years old.[1]

[1] "In England and Wales, and in France, many buildings constructed in the 15th and 16th centuries were roofed with slate, and the roofs are still in excellent condition. There is a record of a chapel in Bedford-on-Avon in Wiltshire, England, roofed with slate in the 8th century, and after 1200 years of climatic exposure is moss-covered but in good condition."

Contrary to the general impression, however, the major portion of the slate produced in the United States is used on the inside rather than the outside of buildings. Its interior uses include stationary washtubs, electrical switchboards, and blackboards.

A square of roofing slate is a sufficient number of pieces of any size to cover 100 square feet of roof, with allowance generally for a three-inch lap. The sizes of the pieces of slate making up a square range from 7 x 9 inches to 16 x 24 inches, and the number of pieces in a square ranges from 85 to 686. The Ferry Building, San Francisco, is roofed with Eureka slate from El Dorado County.

In California, there were shipments in 1926 totaling $7,371 in value, including shingles, flagging, and crushed material for roofing granules, from El Dorado and Riverside counties. The Riverside product was split to 1½–2½ in. thickness for flagging.

[1] Bowles, O., Slate as a permanent roofing material: U. S. Bur. of M., Reports of Investigations, Serial No. 2267, July, 1921, p. 4.

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Total Production of Slate in California.

A complete record of amount and value of slate produced in California follows:

Year	Squares	Value	Year	Squares	Value
1889	4,500	$18,089	1905	4,000	$40,000
1890	4,000	24,000	1906	10,000	100,000
1891	4,000	24,000	1907	7,000	60,000
1892	3,500	21,000	1908	6,000	60,000
1893	3,000	21,000	1909	6,961	45,660
1894	1,800	11,700	1910	1,000	8,000
1895	1,350	9,450	1911		
1896	500	2,500	1915	1,000	5,000
1897	400	2,800	1916		
1898	400	2,800	1920	8	80
1899	810	5,900	1921		
1900	3,500	26,250	1922	*	*
1901	5,100	38,250	1923		
1902	4,000	30,000	1926		7,371
1903	10,000	70,000			
1904	6,000	50,000	Total value		$683,850

*Concealed under 'Unapportioned.'

MISCELLANEOUS STONE.

Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38; also annual statistical bulletins from 1915 to date.

'Miscellaneous stone' is the name used throughout this report as the title for that branch of the mineral industry covering crushed rock of all kinds, paving blocks, sand and gravel, and pebbles for grinding mills. The foregoing are very closely related from the standpoint of the producer; therefore it has been found to be most satisfactory to group these items as has been done in recent reports of this Bureau. So far as it has been possible to do so, crushed rock production has been subdivided into the various uses to which the product was put. It will be noted, however, a very large percentage of the output has been tabulated under the heading 'Unclassified.' This is necessary because of the fact that many of the producers have no way of telling to what specific use their rock was put (or at least the proportions to each use) after they have quarried and sold the same to distributors and contractors.

In addition to amounts produced by commercial firms, both corporations and individuals, there is hardly a county in the state but uses more or less gravel and broken rock on its roads. Of much of this, particularly in the country districts, there is no definite record kept.

For the year 1926, crushed rock registered gains both in tonnage and value over the preceding year; as did also sand and gravel. The result was a total value of $19,859,873 as compared with $17,409,854 in 1925. Continuance of general building work and highway paving are in part responsible as well as hydro-electric power-plant installations and harbor protection (breakwater and jetty construction).

As for some years past, Los Angeles County led all others by a wide margin with an output valued at $7,472,884 (compared with $6,978,605 in 1925); followed by Alameda, second, with $1,642,618; Riverside, third, $1,180,278; Nevada, fourth, $850,000; Contra Costa, fifth, $766,-

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921; Humboldt, sixth, $700,736; San Diego, seventh, $529,640; Santa Clara, eighth, $478,231; followed in turn by Sacramento, Marin, San Bernardino, Fresno, Ventura, San Benito, Siskiyou, Orange, Imperial, Stanislaus, Monterey, in the order named, each with a total between a half- and a quarter-million dollars value.

Paving Blocks.

The paving block industry has decreased materially of recent years, practically to the vanishing point, because of the increased construction of smoother pavements demanded by motor-vehicle traffic. The blocks made in Solano County were of basalt; those from Sonoma are of basalt, andesite, and some trachyte, while those from Placer, Riverside, San Bernardino, and San Diego are of granite.

There was no production in 1926.

The amount and value of paving block production annually since 1887 has been as follows:

Year	Amount M	Value	Year	Amount M	Value
1887	*10,000	$350,000	1908	7,660	$334,780
1888	10,500	367,509	1909	4,503	199,803
1889	7,303	297,236	1910	4,434	198,916
1891	7,000	245,000	1911	4,141	210,819
1892	5,000	150,000	1912	11,018	578,355
1893	*3,000	96,000	1913	6,364	363,505
1894	2,770	96,950	1914	6,053	270,598
1895	2,517	66,981	1915	3,285	171,092
1896	2,332	73,338	1916	1,322	54,362
1897	4,161	77,584	1917	938	38,567
1898	1,711	35,235	1918	372	17,000
1899	1,144	21,725	1919	27	1,350
1900	305	7,861	1920	63	3,155
1901	1,192	23,775	1921	4	280
1902	1,920	41,075	1922	72	3,924
1903	3,502	112,437	1923	15	880
1904	4,854	134,642	1924	11	935
1905	3,977	161,752	1925	27	1,350
1906	3,408	134,347	1926		
1907	4,203	173,432			
	4,604	199,347	Totals	135,702	$5,315,888

*Figures for 1887-1892 (inc.) are for Sonoma County only, as none are available for other counties during that period though Solano County quarries were then also quite active.

Grinding Mill Pebbles.

Production of pebbles for tube and grinding mills began commercially in California in 1915. Owing to the decreased imports and higher prices of Belgium and other European flint pebbles, due to the war, there was a serious inquiry for domestic sources of supply. In 1916 and 1917 shipments totaled in excess of 20,000 tons per year; but they have since dropped to an insignificant figure. San Diego County has been the principal contributor, with some also from Fresno and Sacramento. Shipments have been made to metallurgical plants in California, Nevada, Montana and Utah.

Imports in 1926 amounted to 13,474 long tons, valued at $120,078 compared with 14,500 long tons and $105,041 in 1925.

Californian output for 1926 was 102 tons, valued at $612, a decrease from the 1925 figures.

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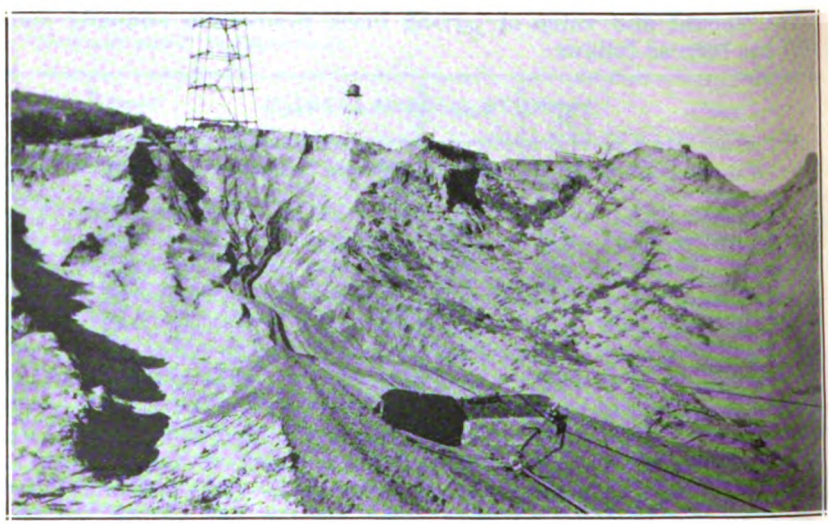
The amount and value of grinding mill pebbles, annually, follows:

Year	Tons	Value
1915	340	$2,810
1916	20,232	107,567
1917	21,450	90,538
1918	8,628	61,268
1919	2,607	19,272
1920	2,104	17,988
1921	247	1,418
1922	1,571	7,628
1923	2,650	14,936
1924	434	2,969
1925	215	1,385
1926	102	612
Totals	60,580	$258,391

Sand and Gravel.

A considerable part of the gravel excavated is passed through grading and washing plants, and the material over 2 inches in size is crushed.



E. B. & A. L. Stone Company's sand pit, near Antioch, Contra Costa County. Photo by C. McK. Laizure.

Much of it is utilized in concrete mixtures. Most of the gravel used for road surfacing and repairs as well as that for railroad ballast is creek-run or pit-run material which is spread upon the roads without undergoing any grading or washing.

The distribution of the 1926 output of sand and gravel, by counties, is given in the following table:

County	Tons	Value
Alameda	[a] 1,702,771	$1,245,607
Amador	14,000	12,400
Butte	122,333	52,550
Calaveras	4,000	1,500
Colusa	100,222	75,167
Contra Costa	[a] 170,413	94,084
Del Norte	42,833	37,100
El Dorado	380	260
Fresno	240,959	149,753
Glenn	167,048	58,391

[a] Includes molding sand.

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Humboldt	177,278	92,243
Imperial	287,216	238,235
Kern	65,450	28,000
Lassen	19,412	18,995
Los Angeles	6,830,507	4,504,602
Mariposa	12,666	9,500
Merced	316,102	150,196
Modoc	20,275	36,450
Monterey	[c] 274,296	236,244
Napa	19,720	19,270
Nevada	36,360	66,500
Orange	[d] 305,159	248,767
Riverside	[ae] 3,723	11,218
Sacramento	[ad] 470,725	257,879
San Benito	51,055	9,460
San Bernardino	186,914	146,735
San Diego	[a] 689,601	478,428
San Francisco	[a] 54,597	60,887
San Joaquin	221,338	129,037
San Mateo	15,180	11,857
Santa Barbara	55,453	35,009
Santa Clara	448,594	342,811
Santa Cruz	[a] 23,666	18,175
Shasta	71,239	44,545
Siskiyou	[f] 350,957	52,569
Sonoma	256,544	113,997
Stanislaus	316,344	226,201
Tulare	52,955	39,831
Ventura	[a] 291,821	265,711
Yuba	214,700	133,298
Alpine, Lake, Madera, Marin, Mendocino, Mono,[b] Placer, San Luis Obispo,[a] Sierra, Tehama, Trinity, Tuolumne, Yolo[e]	164,419	110,855
Totals	14,869,225	$9,864,317

[a] Includes molding sand.
[b] Includes white building sand.
[c] Includes molding (core), building, stucco, glass, filter, roofing, and miscellanous sand, mainly washed.
[d] Includes special plaster sand.
[e] Includes stucco sand.
[f] Includes volcanic cinders (ash) used for railroad ballast.
[e] Combined to conceal output of a single operator in each.

Included in the above is a total of 46,601 tons of molding sand, valued at $105,336 f.o.b. pit, from two operators each in Alameda and San Diego counties, and one each in Contra Costa, Monterey, Riverside, Sacramento, San Francisco, San Luis Obispo, Santa Cruz, and Ventura. This item is each year assuming a more important position in the commercial mineral list of California. The 1925 figures totaled 45,964 tons and $76,974.

Crushed Rock.

To list the kinds and varieties of rock utilized commercially under this heading would be to run almost the entire gamut of the classification scale. Much depends on the kind available in a given district. Those which give the most satisfactory service are the basalts and other hard, dense, igneous rocks which break with sharp, clean edges. In many localities, river-wash boulders form an important source of such material. In such cases, combined crushing and washing plants obtain varying amounts of sand and gravel along with the crushed sizes. In Sacramento and Butte counties the tailings piles from the gold dredgers are the basis of like operations.

The values given are based on the selling prices, f.o.b. cars, barges, or trucks, at the quarry.

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Crushed Rock Production, by Counties, for 1926.

County	Macadam and ballast		Rubble and riprap		Concrete		Unclassfied		Total	
	Tons	Value	Tons	Value	Tons	Value	Tons	Value	Tons	Value
Alameda	143,346	$115,434			231,945	$260,941	17,627	$20,636	392,918	$397,011
Amador	6,000	7,500					[a]350	5,000	6,350	12,500
Butte	5,000	5,000			23,951	22,454	[b]78,000	67,600	106,951	95,054
Calaveras	4,000	2,000					[c]5,020	55,500	9,020	57,500
Contra Costa	187,848	178,213	13,033	$7,945	231,512	232,586	313,864	254,093	746,257	672,837
Del Norte	26,900	31,150							26,900	31,150
El Dorado	4,900	17,250							4,900	17,250
Fresno	31,527	19,396			151,015	148,707	90,725	70,699	273,267	238,802
Humboldt	11,000	14,000	213,230	584,250			8,536	10,243	232,766	608,493
Imperial	51,291	63,065	64,980	10,830					116,271	73,895
Inyo	6,000	12,000							6,000	12,000
Los Angeles	959,378	964,682	11,862	23,204	939,371	944,658	1,131,328	998,180	3,086,125	2,968,282
Mariposa	42,930	64,395			24,985	37,478	[d][e]5,460	19,431	73,375	121,304
Merced	11,956	5,290			2,666	1,000			14,622	6,290
Monterey							30,000	27,000	30,000	27,000
Napa	59,225	45,316			143,296	143,296			202,521	188,612
Nevada	13,300	39,000	403,000	558,000	192,666	186,500			608,966	783,500
Orange	30,000	15,000			54,000	54,000			84,000	69,000
Placer	19,821	34,292	2,012	2,054	*				21,833	36,346
Riverside			[f]828,300	833,000	524,492	333,860	[g]200	2,200	1,352,992	1,169,060
Sacramento	2,100	1,050	3,786	1,514	8,752	10,223	441,840	167,420	456,478	180,207
San Bernardino	96,210	215,262	33,350	33,350	156	2,000	[h]7,324	7,394	137,040	257,946
San Diego	2,800	2,100	350	500	666	1,000	40,700	47,000	44,516	50,600
San Francisco	24,848	24,227			25,348	26,659	200	420	50,396	51,306
San Luis Obispo	182,248	189,538							182,248	189,538
San Mateo	33,490	23,151			14,464	39,337	7,333	3,125	55,287	65,613
Santa Barbara	10,000	7,500					49,575	46,066	59,575	53,566
Santa Clara	6,000	3,375					168,862	132,045	174,862	135,420
Shasta	[i]89,085	42,810			100,000	75,000			189,085	117,810
Siskiyou	200,000	175,000			100,000	100,000			300,000	275,000
Sonoma	24,761	16,583	68	51	49,100	73,446	5,869	4,402	79,798	94,482
Tulare	46,700	23,350			3,000	4,200	[j]900	6,500	50,600	34,050

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Tuolumne	32,600	36,500			6,065	9,097	[k] 1900	8,000	39,565	53,597
Ventura	28,000	48,000	11,600	17,400			10,572	8,324	50,172	73,724
Alpine, Mendocino, San Benito, Sutter, Tehama, Trinity*	299,128	213,848							299,128	213,848
Madera, Marin*			54,312	69,121					54,312	69,121
Marin, Placer, San Benito, Santa Cruz, Sierra*					371,659	339,280			371,659	339,280
Marin, Stanislaus*							127,626	153,950	127,626	153,950
Totals	2,692,392	$2,655,217	1,639,883	$2,141,219	3,190,100	$3,045,722	2,542,811	$2,115,228	10,118,381	$9,994,944

*Combined to conceal output of a single operator in each.
[a] Includes red roofing granules.
[b] Includes green serpentine marble for terrazzo, roofing and stucco dash.
[c] Includes greenstone roofing granules.
[d] Includes green jasper for roofing granules.
[e] Includes slate used for roofing granules.
[f] Includes sling stone up to 20 tons each, for harbor breakwater construction.
[g] Includes schist for stucco dash granules.
[h] Includes roofing granules.
[i] Includes smelter slag used for railroad ballast.
[j] Includes granite for stucco dash granules.
[k] Includes marble granules for terrazzo and stucco dash.
[l] Includes mariposite for stucco dash granules.

Miscellaneous Stone Production of California, by Years.

The amount and value, annually, of crushed rock (including macadam, ballast, rubble, riprap, and that for concrete), and sand and gravel, since 1893, follow:

Crushed Rock, Sand and Gravel, by Years.

Year	Tons	Value	Year	Tons	Value
1893	371,100	$456,075	1911	6,487,223	$3,610,357
1894	661,900	664,838	1912	8,044,937	4,532,768
1895	1,254,688	1,095,939	1913	9,817,616	4,823,056
1896	960,619	839,884	1914	9,288,397	3,960,973
1897	821,123	600,112	1915	10,879,497	4,609,278
1898	1,177,365	814,477	1916	9,951,089	4,009,540
1899	964,898	786,892	1917	8,069,271	3,505,092
1900	789,287	561,642	1918	6,641,144	3,325,889
1901	530,396	641,037	1919	6,919,188	3,678,322
1902	2,056,015	1,249,529	1920	9,792,122	6,782,414
1903	2,215,625	1,673,591	1921	10,914,145	7,834,540
1904	2,296,898	1,641,877	1922	13,049,644	10,366,231
1905	2,824,257	1,716,770	1923	19,840,301	15,379,838
1906	1,555,372	1,418,406	1924	21,451,129	15,962,476
1907	2,288,888	1,915,015	1925	23,819,137	17,407,113
1908	3,998,945	3,241,774	1926	24,987,606	19,859,261
1909	5,531,561	2,708,326			
1910	5,827,828	2,777,690	Totals	215,879,211	$151,451,572

A comparison of the above table of annual production of these materials with the similar table for cement (see *ante*), reveals the fact that the important growth of the crushed rock and gravel business has been coincident with the rapid development of the cement industry from the year 1902. See also the chart, under cement.

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CHAPTER FIVE.

INDUSTRIAL MATERIALS.

Bibliography: State Mineralogist Reports XII–XXIII (inc.). Bulletin 38. Min. & Sci. Press, Vol. 114, March 10, 1917. Spurr and Wormser, "Marketing of Metals and Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the state but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are limestone, mineral water, pyrites, pottery clays, diatomaceous earth, gypsum, talc, dolomite, fuller's earth.

This group as a whole showed a decrease in the total value to $4,675,924 in 1926 from $5,379,064 for 1925.

The following table gives the comparative figures for the amounts and value of industrial minerals produced in California during the years 1925 and 1926:

Substance	1925		1926		Increase+ Decrease−
	Amount	Value	Amount	Value	Value
Barytes			4,978 tons	$38,165	$38,165+
Clays (pottery)	537,587 tons	$674,376	797,461 tons	806,509	132,133+
Fire clay	42,850 tons	104,900	68,640 tons	119,313	14,413+
Fuller's earth	8,165 tons	59,615	7,300 tons	56,400	3,215−
Gems	5,280 tons	91,842	23,552 tons	250,192	158,350+
Gypsum		10,663		9,049	1,614−
Infusorial earth	107,613 tons	172,444	114,868 tons	211,337	38,893+
Mineral paint	319,977 tons	494,525	108,795 tons	367,501	127,024−
Mineral waters	669 tons	6,969	569 tons	5,846	1,123−
Pumice and volcanic ash	12,115,072 gals.	1,230,455	14,074,877 gals.	1,171,550	58,905−
Pyrites	5,319 tons	32,937	7,170 tons	48,350	15,413+
Sand and quartz	129,500 tons	528,550	100,896 tons	466,088	62,462−
Soapstone and talc	12,498 tons	96,780	30,010 tons	104,317	7,537+
Unapportioned	15,465 tons	239,084	17,004 tons	255,645	16,561+
		[a]1,635,924		[b]765,662	870,262−
Total values		$5,379,064		$4,675,924	
Net decrease					$703,140

[a] Includes asbestos, diatomaceous earth, graphite, shale oil, sillimanite-andalusite.
[b] Includes asbestos, diatomaceous earth, lithia, shale oil, sillimanite-andalusite-cyanite group.

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ASBESTOS.

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXII. Bulletins 38, 91. Canadian Dept. of M., Mines Branch Bulletin 69. Min. & Sci. Press, April 10, 1920, pp. 531-533. Eng. & Min. Jour.-Press, Vol. 113, pp. 617–625, 670–677. Asbestology, Vol. 5, No. 7, July, 1927.

In 1926 there was a small tonnage of crude asbestos ore and fibre produced in California, but as there was only a single operator, the figures are concealed under the 'Unapportioned' item.

The future of asbestos mining in California is dependent largely upon the development of uses in quantity for the short-fibre mill grades, and for the amphibole variety. There are apparently large resources of such material that can be made available. Some spinning-grade fibre has also been found in this state, notably in Nevada, Calaveras, and Monterey counties, but the commercial yield to date has been small. There are extensive serpentine areas in the Coast Ranges, in the Klamath Mountains, and in several sections of the Sierra Nevada which are within the range of possible asbestos producers, as chrysotile is a fibrous form of serpentine. These localities all yielded chromite in greater or less amounts during the World War period.

Three-quarters of the world's supply of asbestos was for many years produced by Canada.

At present, Rhodesia furnishes 60 per cent of the long fibre, though Canada in addition to its long fibre still accounts for practically the entire output of lower grades.

Asbestos Production of California, by Years.

Total amount and value of asbestos production in California since 1887, as given in the records of this Bureau, are as follows:

Year	Tons	Value	Year	Tons	Value
1887	30	$1,800	1908	70	$6,100
1888	30	1,800	1909	65	6,500
1889	30	1,800	1910	200	20,000
1890	71	4,260	1911	125	500
1891	66	3,960	1912	90	2,700
1892	30	1,830	1913	47	1,175
1893	50	2,500	1914	51	1,530
1894	50	2,250	1915	143	2,860
1895	25	1,000	1916	145	2,380
1896			1917	136	10,225
1897			1918	229	9,903
1898	10	200	1919		
1899	30	750	1920	131	6,240
1900	50	1,250	1921	410	19,275
1901	110	4,400	1922	50	1,800
1902			1923	20	200
1903			1924	70	4,750
1904	10	162	1925		
1905	112	2,625	1926	25	1,650
1906	70	3,500			
1907	70	3,500	Totals	2,851	$135,375

*Annual details concealed under 'Unapportioned.'

BARYTES.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XXI. Bulletin 38. Eng. & Min. Jour.-Press, Vol. 114, p. 109, July 15, 1922; Vol. 115, pp. 319-324, Feb. 17, 1923.

Commercial shipments of crude barytes in California in 1926

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amounted to a total of 4978 tons, valued at $38,165 f.o.b. rail-shipping point, coming from properties in Nevada and Mariposa counties. The material was consumed principally in the manufacture of lithopone. The new plant of the Chemical and Pigments Company at Oakland, Alameda County, with a capacity for 25 tons of lithopone daily, began operations during the year. This plant will thus afford an outlet for some of California's zinc ore as well as for barytes.

More than half of the total tonnage of barytes utilized in the United States is taken in the manufacture of lithopone, which is a chemically-prepared white pigment containing approximately 70% barium sulphate and 30% zinc sulphide. This is one of the principal constituents of 'flat' wall paints. Other important uses for barytes, after washing and grinding, are as an inert pigment and filler in paint, paper, linoleums, oilcloth and rubber manufacture, and in the preparation of a number of chemicals including barium binoxide, carbonate, chloride, nitrate, and the sulphate precipitated, or 'blanc fixe.'

Present quotations for barytes vary from $7 to $9 per ton, crude, f.o.b. rail-shipping point, depending on quality. Most baryte has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta and Santa Barbara counties. The deposit at El Portal, in Mariposa County, has given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

Total Barytes Production of California.

The first recorded production of barytes in California, according to the statistical reports of the State Mining Bureau, was in 1910. The annual figures are as follows:

Year	Tons	Value	Year	Tons	Value
1910	860	$5,640	1920	3,029	$20,795
1911	309	2,207	1921	901	4,809
1912	564	2,812	1922	3,370	18,925
1913	1,600	3,680	1923	2,925	16,058
1914	2,000	3,000	1924		
1915	410	620	1925		
1916	1,606	5,516	1926	4,978	38,165
1917	4,420	25,633			
1918	100	1,500	Totals	28,573	$167,425
1919	1,501	18,065			

CLAY (Pottery).

Bibliography: State Mineralogist Reports I, IV, IX, XII–XV, XVIII–XXIII (inc.). Bulletin 38. Preliminary Report No. 7. U. S. Bureau of Standards, Tech. Paper No. 262.

At one time or another in the history of the state, pottery clay has been mined in thirty-three of its counties. Of these, 20 contributed in 1926. In this report, 'pottery clay' refers to all clays used in the manufacture of red and brown earthenware, china and sanitary ware, flowerpots, floor, faience and ornamental tiling, architectural terra cotta,

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sewer pipe, drain and roof tile, etc., and the figures for amount and value are relative to the crude material at the pit, without reference to whether the clay was sold in the crude form or was immediately used in the manufacture of any of the above finished products by the producer. It does not include clay used in making brick and hollow building blocks.

There are many other important uses for clays besides pottery manufacture. Among these may be enumerated paper, cotton goods, and chemicals. Being neutral, clay does not have an injurious effect upon other constituents used in the manufacture of such articles. In paper making, clay is used as a filler in news and similar grades, and as a coater or glazer in the more highly-finished art papers. A large part of the china clay used in the United States is imported from England. Clays of the montmorillonite and halloysite group ('rock soap') are being utilized successfully in the manufacture of soaps.

Harvey clay pit of Pacific Portland Cement Company, near Carbondale, Amador County. Photo by C. A. Logan.

During 1926, a total of 65 producers in 20 counties reported an output of 801,461 short tons of pottery clay, having a total value of $806,509 f.o.b. rail-shipping point, for the crude material, as compared with the 1925 production of 537,587 tons worth $674,376.

Because of the fact that a given product often requires a mixture of several different clays, and that these are not all found in the same pit, it is necessary for most clay-working plants to buy some part of their raw materials from other localities. For these reasons, in compiling the clay industry figures, much care is required to avoid duplications. So far as we have been able to segregate the figures, from the data sent in by the operatives, we have credited the clay output to the counties from which the raw material originated; and have deducted tonnages used in brick manufacture, as bricks are classified separately, herein.

A tabulation of the direct returns from the producers, by counties, for the year 1926, is shown herewith:

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Pottery Clay, in 1926.

County	Tons	Value	Used in the manufacture of—
Alameda	5,870	$7,183	Drain, faience, floor, quarry and roofing tile, sewer pipe.
Amador	97,768	135,767	Architectural terra cotta, fire clay products, chimney and sewer pipe, refractories, drain, floor and roofing tile, and various.
Contra Costa	7,675	5,688	Architectural terra cotta, sewer pipe, faience and drain tile.
Los Angeles	[a]86,767	99,076	Architectural terra cotta, conduit, red earthenware, refractories, drain, faience, floor and roofing tile, crushed brick and tile, chimney and sewer pipe, and oil-well mudding.
Monterey	491	1,164	Floor and roofing tile.
Orange	13,150	38,989	Conduit pipe and stoneware, refractories, drain and roofing tile, and various.
Placer	104,250	147,241	Architectural terra cotta, chimney, sewer and conduit pipe, drain, floor and roofing tile, sanitary ware, red earthenware and various.
Riverside	58,528	178,383	Conduit and sewer pipe, red earthenware, refractories, roofing tile and various.
Sacramento	1,548	2,310	Crushed brick, faience tile et al.
San Bernardino	[b]2,268	10,605	Porcelain.
San Diego	[c d]30,187	58,269	Therapeutic clay, sewer pipe, faience, floor and roofing tile, and various.
Santa Barbara	1,100	1,700	Drain, floor and roofing tile.
Ventura	[a]373,000	93,250	Oil-well drilling mud.
Butte, Calaveras, Humboldt, Merced, San Luis Obispo, Santa Clara, Sonoma [b e]	18,859	26,884	Earthenware, procelain, chimney and sewer pipe, drain and roofing tile.
Totals	801,461	$806,509	

[a] Combined to conceal output of a single operator in each.
[a] Includes clay and shale for oil-well drilling mud.
[b] Includes kaolin.
[c] Includes 'Cornwall' stone.
[d] Includes therapeutic clay.

Pottery Clay Products.

The values of the various pottery clay products made in California during 1926 totaled $14,625,203, compared with $13,621,431 in 1925, their distribution being shown in the following tabulation:

Products	*Number of producers*	*Tons*	*Value*
Architectural terra cotta	5	15,954	$2,361,524
Chimney pipe, terra cotta and flue lining	10	13,207	461,786
Drain tile	12	7,178	113,168
Roofing tile	24	73,984	1,917,415
Sewer pipe	10	100,689	2,910,567
Chinaware and semi-vitreous tableware	3	------	627,516
Sanitary ware	6	------	1,894,705
Red earthenware	6	------	198,308
Stoneware and chemical stoneware	6	------	434,772
Floor, faience, mantel, glazed and hand-made tile	27	------	2,867,772
Miscellaneous art pottery, bisque ware, brick dust, calcined clay, ceramic mosaic wall tiles, conduit, conduit pipe, fire clay products, crushed brick and tile, garden furniture and pottery, high temperature cement, porcelain, gas radiants and backs, cast stone, ground clay, fire clay and grog, broken tile and various	23	------	837,670
Total value			$14,625,203

Important increases were shown by sewer pipe, roofing tile, and flat tile (floor, faience, mantel, etc.), with decreases by architectural terra cotta, chimney pipe, and the miscellaneous group.

Value of Clay Products of the United States.

The Census Bureau of the U. S. Department of Commerce announces[1] as a result of its canvass of returns for 1926, that the total value of

[1] U. S. Census Bureau, Press Bulletin, Sept. 14, 1927.

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clay products and non-clay refractories in the United States for the year was $459,049,470, an increase of 2.6% as compared with $447,603,889 in 1925. The value for 1926 is made up as follows: Brick, tile and other clay products except pottery, $317,953,545; pottery, $116,488,308; non-clay refractories, $24,505,519. These values represent increases of 1%, 4%, and 20.3%, respectively, over 1925.

Of the 2391 establishments classified in these industries for 1926, there were 381 in Ohio, 329 in Pennsylvania, 145 in Illinois, 127 in New Jersey, 125 in New York, 106 in California, 95 in Indiana, 76 in North Carolina, 70 in Texas, 66 in Missouri, 51 in Iowa, and the remaining 820 in 38 other states and the District of Columbia.

Pottery Clay Production of California, by Years.

Amount and value of crude pottery clay output in California since 1887 are given in the following table:

Year	Tons	Value	Year	Tons	Value
1887	75,000	$37,500	1908	208,042	$325,147
1888	75,000	37,500	1909	299,424	465,647
1889	75,000	37,500	1910	249,028	324,099
1890	100,000	50,000	1911	224,576	252,759
1891	100,000	50,000	1912	199,605	215,683
1892	100,000	50,000	1913	231,179	261,273
1893	24,856	67,284	1914	179,948	167,552
1894	28,475	35,073	1915	157,866	133,724
1895	37,660	39,685	1916	134,636	146,538
1896	41,907	62,900	1917	166,298	154,602
1897	24,592	30,290	1918	112,423	166,788
1898	28,947	33,747	1919	135,708	245,019
1899	40,600	42,700	1920	203,997	440,589
1900	59,636	60,956	1921	225,120	362,172
1901	55,679	39,144	1922	277,232	473,184
1902	67,933	74,163	1923	376,863	697,841
1903	90,972	99,907	1924	417,928	651,857
1904	84,149	81,952	1925	537,587	674,376
1905	133,805	130,146	1926	797,461	806,509
1906	167,267	162,283			
1907	160,385	254,454	Totals	6,706,784	$8,442,643

DOLOMITE.

Bibliography: Reports XV, XVII–XXII (inc.). Bulletins 67, 91.

The production of dolomite for the year 1926 totaled 68,640 tons valued at $119,313, being an increase in both quantity and value over the 1925 figures of 42,852 tons and $104,900, though less than the record yield of 1923. The 1926 output came from a single quarry each in Inyo, Monterey and San Benito counties. The material shipped was utilized for steel furnace flux and refractories, and for manufacture of CO_2. Some, previously has been used for burned dolomitic lime, for stucco dash-coat, and terrazzo.

Dolomite Production of California, by Years.

Previous to the 1915 statistical report of the State Mining Bureau, dolomite was included under limestone, as the two minerals are closely related chemically; but since dolomite, as such, has been found to have certain distinctive applications, we now give it a separate classification.

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Amount and value of the output of dolomite, annually, have been as follows:

Year	Tons	Value
1915	4,192	$14,504
1916	13,313	46,566
1917	27,911	66,416
1918	24,560	79,441
1919	24,502	67,953
1920	42,388	132,791
1921	31,195	99,155
1922	52,409	114,911
1923	69,519	142,615
1924	28,843	71,271
1925	42,852	104,900
1926	68,610	119,313
Totals	430,324	$1,059,836

FELDSPAR.

Bibliography: State Mineralogist Reports XV, XVII, XVIII, XXI. Bulletins 67, 91. U. S. Bureau of Mines, Bulletin 92. Eng. & Min. Jour.-Press, Vol. 115, pp. 535–538, Mar. 24, 1923.

Feldspar was produced by four operators in three counties (Kern, Riverside and San Diego) during 1926, to the amount of 7300 tons, valued at $56,400, being a slight decrease both in quantity and value from the 1925 figures, which were 8165 tons and $59,615.

The requirements of the pottery trade demand that in general the percentage of free silica associated with the feldspar be less than 20%, and in some cases the potters specify less than 5%. An important factor, also, is the iron-bearing minerals frequently present in pegmatites and granites, such as biotite (black mica), garnet, hornblende, and black tourmaline. Feldspar for pottery uses should be practically free of these. The white, potash-mica, muscovite, is not particularly objectionable except that, being in thin, flexible plates, it does not readily grind to a fineness required for the feldspar.

Present quotations are from $5 to $8 per ton, crude, according to quality.

The most important developments quantitatively in the feldspar resources of California have thus far taken place in San Diego and Riverside counties, where large deposits of massive, high-grade spar are being opened up. These deposits are unusually free from black mica and other deleterious iron-bearing minerals objectionable in pottery work. The important producing districts are near Lakeside and Campo, in San Diego County, and near Lakeview, Murrietta, and Elsinore, in Riverside County. Other deposits which give promise are reported from Inyo, Kern and San Bernardino counties. No recent shipments have been reported from Monterey and Tulare counties, formerly important sources.

Total Feldspar Production of California.

Total amount and value of feldspar production in California since the inception of the industry are given in the following table, by years:

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Year	Tons	Value	Year	Tons	Value
1910	760	$5,720	1920	4,518	26,189
1911	740	4,560	1921	4,349	28,343
1912	1,382	6,180	1922	4,587	37,109
1913	2,129	7,850	1923	11,100	81,800
1914	3,530	16,565	1924	9,055	68,112
1915	1,800	9,000	1925	8,165	59,615
1916	2,630	14,350	1926	7,300	56,400
1917	11,792	46,411			
1918	4,132	22,061	Totals	79,241	$503,225
1919	1,272	12,965			

FLUORSPAR.

Bibliography: State Mineralogist Reports XVII, XVIII. Bulletins 67, 91. Eng. & Min. Jour.-Press, Vol. 117, pp. 489–492, Mar. 22, 1924.

Fluorspar, or calcium fluoride, CaF_2, is one of the most important non-metallic minerals from an industrial standpoint. About 80% of the commercial mineral is prepared in the 'gravel' form and utilized as a flux in the manufacture of steel, for which use no substitute has yet been found. In the United States, under normal business conditions, the consumption for that purpose is 125,000 to 150,000 tons annually. Fluorspar is also used in aluminum smelting, and in the manufacturing of enameled ware, glazed tile and brick, opalescent glass and certain chemicals, particularly hydrofluoric acid and its derivatives. The mineral is marketed in three forms: lump, gravel, and ground.

According to the U. S. Bureau of Foreign and Domestic Commerce, imports of fluorspar into the United States in 1926 amounted to 67,563 long tons, valued at $747,237, and came principally from England, with smaller amounts from British South Africa, Italy, China and Netherlands. Domestic shipments of fluorspar, according to the U. S. Bureau of Mines, totaled 128,657 short tons, valued at $2,341,277.

In California deposits have been reported in Los Angeles, Mono, Riverside and San Bernardino counties, but no commercial production has resulted except in 1917–1918, when a total of 79 tons valued at $991 was shipped from Riverside County.

The Tariff Act of 1922 places a duty of $5.60 per ton on foreign importations of fluorspar.

Present quotations (Engineering and Mining Journal, New York) are f.o.b. Middle Western Mines, per net ton: Gravel, not less than 85% CaF_2 and not over 5% SiO_2, $17–$18; foundry lump, $20.

FULLER'S EARTH.

Bibliography: State Mineralogist Reports XIV, XVII, XVIII, XXI. Bulletins 38, 91. U. S. Bureau of Mines, Bulletin 71. Eng. & Min. Jour.-Press, Vol. 121, pp. 837–842, May 22, 1926.

Fuller's earth includes many kinds of unctuous clays. It is usually soft, friable, earthy, nonplastic, white and gray to dark green in color, and some varieties disintegrate in water. In California, fuller's earth

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has been used in clarifying both refined mineral and vegetable oils, and for special chemical purposes; although its original use was in fulling wool, as the name indicates. Production has come mainly from Calaveras and Solano counties, with other deposits noted also in Riverside, Fresno, Inyo and Kern counties.

Clays of the montmorillonite and halloysite group ('rock soap') are being utilized by some of the oil refineries in lieu of true fuller's earth in the refining of petroleum products.

The production of 23,552 tons valued at $250,192 here credited to 1926 as 'fuller's earth' is in reality colloidal clay of the montmorillonite class (sold under such local names as 'bentonite,' 'otaylite,' 'shoshonite,' derived from the locality where found). Because of its being utilized for clarifying, filtering, and cleanser purposes, most of it in petroleum refining, we have placed it, for the purpose of the State Mining Bureau's statistical reports, under the fuller's earth heading.

After all, the practical test of a fuller's earth is not so much chemical, as a physical one; that is, its physical capacity to absorb basic colors and to remove these colors from solution in animal, vegetable, or mineral oils, also from water.

The 1926 output above noted is an increase in both amount and value over the 5280 tons and $91,842 in 1925, and came from seven properties, in Inyo, Kern, San Bernardino, and San Diego counties.

The industrial applications of the montmorillonite (or 'bentonite,' as it is more commonly referred to) group of clays are numerous. According to Melhase:[1]

"Bentonite has been used to a limited extent in soaps and detergent preparations, in paints, pigments, and stove polish. Tests indicate that it may have a further field of usefulness in the manufacture of cements and plasters, in the ceramic industry, and in the preparation of dyes, emulsions, explosives, and fertilizers. Horticultural sprays, animal dips, lubricants, and absorbents may employ bentonite as an ingredient. Bentonite is used in de-inking newspapers, in foundry work, in the manufacture of pencils, crayons, and ink, and in the preparation of various pharmaceuticals and cosmetics.

"Bentonites in which the characterizing mineral is leverrierite are extensively used in the preparation of water softeners. The California bentonites are used chiefly by local refineries for cleaning heavy lubricating oils, kerosene, and gasoline. In preparing the bentonite for this purpose, it is first dried at a temperature of 230 deg. F. It is then ground to an impalpable powder and treated for several hours with 96 per cent sulphuric acid, about 45 per cent by weight of acid being found more efficient. The acid-soluble impurities being thus eliminated, the clay is then drained and thoroughly washed with clean water.

"Refining Processes.

"The prepared clay is then placed in agitators together with the oil to be treated and the mixture thoroughly agitated with steam at 240 to 300 deg. F. From the agitators the mixture goes to settling tanks and then to filter presses, which remove the suspended clay from the now decolorized oil. The amount of clay used ranges from 1 lb. per barrel for gasoline to 100 lbs. per barrel for dark, heavy, lubricating oils. The efficiency of acid-treated bentonite is much greater than that of fuller's earth.

"When used in the treatment of gasoline or light oils the clay may be used several times without rejuvenation, but with the darker oils it becomes necessary to wash and rejuvenate the clay after each application. This process can not, however, be continued indefinitely, as the clay loses a portion of its efficiency with each rejuvenation, and after the third treatment it is found more satisfactory to replace the old clay with a fresh supply."

[1] Melhase, John, Mining bentonite in California: Eng. & Min. Jour.-Press, Vol. 121, p. 842, May 22, 1926.

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Fuller's Earth Production of California, by Years.

Fuller's earth was first produced commercially in this state in 1899, and the total amount and value of the output since that time are as follows:

Year	Tons	Value	Year	Tons	Value
1899	620	$12,400	1914	760	$5,928
1900	500	3,750	1915	692	4,002
1901	1,000	19,500	1916	110	550
1902	987	19,246	1917	220	2,180
1903	250	4,750	1918	37	333
1904	500	9,500	1919	385	3,810
1905	1,344	38,000	1920	600	6,000
1906	440	10,500	1921	1,185	8,295
1907	100	1,000	1922	6,606	48,756
1908	50	1,000	1923	3,650	55,125
1909	459	7,385	1924	5,290	67,295
1910	340	3,820	1925	5,280	91,842
1911	466	5,294	1926	23,552	250,192
1912	876	6,500			
1913	460	3,700	Totals	56,759	$690,653

NOTE.—Above production since 1921 has been montmorillonite (hydrous aluminum silicate) a collodial clay, sometimes called 'rock soap' and 'bentonite,' and in part locally called 'shoshonite' from its being found near Shoshone in Inyo County; and in part 'otaylite' from Otay, San Diego County.

GEMS.

Bibliography: State Mineralogist Reports II, XIV, XV, XVII, XVIII, XX, XXI. Bulletins 37, 67, 91. U. S. G. S., 'Mineral Resources of the U. S.'; Bull. 603, p. 208. Bull. Dept. Geol. Univ. of Cal., Vol. 5, pp. 149–153, 331–380. Am. Jour. Sci., Vol. 31, p. 31.

The production of gem materials in California has been somewhat irregular and uncertain since 1911. The compilation of complete statistics is difficult owing to the widely scattered places at which stones are gathered and marketed for the most part in a small way. The material reported in 1926 totaled $9,049 in value, compared with $10,663 in 1925, the decrease being due mainly to San Diego County.

The following table shows the distribution of rough, uncut gem and jeweler's materials during 1926:

County	*Value*	*Kind*
Butte	$175	Diamonds and saphires.
San Diego	4,000	Tourmaline, spessartite garnet, pink and aquamarine beryl, blue topaz, kunzite.
Calaveras, Inyo, Sonoma	* 4,874	Quartz crystals. Gneiss. Quartz and chalcedony.
Total value	$9,049	

* Combined to conceal output of a single operator in each.

Varieties of California's Gem Stones.

Diamonds have been found in a number of localities in California; but in every case, they have been obtained in stream gravels while working them for gold. The principal districts have been: Volcano in

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Amador County; Placerville, Smith's Flat and others in El Dorado County; French Corral, Nevada County; Cherokee Flat, Morris Ravine, and Yankee Hill, Butte County; Gopher Hill and upper Spanish Creek, Plumas County. The most productive district of recent years has been Cherokee in Butte County.

California *tourmalines* are decidedly distinctive in coloring and 'fire' as compared to foreign stones of this classification. The colors range from deep ruby to pink, and various shades of green, also blue.

One of our California gem stones, *benitoite,* has not been found elsewhere; and in but a single locality here: The Dallas Mine in San Benito County.

Kunzite, a gem variety of spodumene, was first found in the Pala district in San Diego County. It has thus far been found in only one locality (Madagascar) outside of California. It is of a lilac color, and is described in detail in Bulletin 37 of the State Mining Bureau.

Beryls of excellent fire and delicate colors are also obtained in the Pala district, of which the *aquamarine* (blue) and *morganite* (pink) varieties deserve special mention. Morganite, like kunzite, has thus far been found elsewhere only in Madagascar.

Californite, or 'California jade,' is a gem variety of *vesuvianite,* and is green or white in color. It is found in Butte, Fresno, and Siskiyou counties.

Stones of precious blue *topaz* of fine quality are being cut from crystals mined in northern San Diego County. They are associated with beryl and blue tourmaline.

Some *rhodonite* has been mined in Siskiyou County, and used for decorative purposes, its value being included in the marble figures.

Garnets are found in a number of localities in California; the important yield of gems being *hyacinth* and *spessartite* varieties from San Diego County.

Chrysoprase has been produced in Tulare County.

Turquoise has been found in the desert section of San Bernardino County, but none produced commercially in recent years.

Sapphires have been reported found in San Bernardino and Riverside counties, but not as yet confirmed. A few have been found in stream gravels with diamonds in Butte County.

Rubies have been identified by the laboratory of the State Mining Bureau, occurring in limestone from the Baldy Mountains, San Bernardino County. Thus far no stones of commercial size have been taken out.

Total Production of Gem Materials in California.

The value of the gem output in California annually since the beginning of commercial production is as follows:

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Year	Value	Year	Value
1900	$20,500	1915	$3,565
1901	40,000	1916	4,752
1902	162,100	1917	3,049
1903	110,500	1918	650
1904	136,000	1919	5,425
1905	148,500	1920	36,056
1906	497,090	1921	10,954
1907	232,642	1922	1,312
1908	208,950	1923	13,220
1909	193,700	1924	4,800
1910	237,475	1925	10,663
1911	51,824	1926	9,049
1912	23,050		
1913	13,740	Total value	$2,183,536
1914	3,970		

GRAPHITE.

Bibliography: State Mineralogist Reports XIII, XIV, XV, XVII. Bulletins 67, 91. U. S. G. S., Min. Res., 1914, Pt. II.

Graphite (also called plumbago) has been produced from time to time in the state, coming principally from Sonoma and Los Angeles counties. It is difficult for these deposits, which must be concentrated, to compete with foreign supplies, which go on the market almost directly as they come from the deposit. Graphite ores are concentrated with considerable difficulty, and the electric process of manufacturing artificial graphite from coal has been perfected to such a degree that only deposits of natural graphite of a superior quality can be exploited with any certainty of success.

According to the U. S. Geological Survey, operators in this country who are working disseminated flake deposits must depend on their No. 1 and No. 2 flake for their profit. Graphite dust is merely a by-product and is salable only at a low price.

The principal value of graphite is on account of its infusibility and resistance to the action of molten metals. It is also largely used in the manufacture of electrical appliances, of 'lead' pencils, as a lubricant, as stove polish, paints, and in many other ways. Amorphous graphite, commonly carrying many impurities, brings a much lower price. For some purposes, such as foundry facings, etc., the low-grade material is satisfactory. Among the interesting uses for graphite is the prevention of formation of scale in boilers. The action is a mechanical one. Being soft and slippery, the graphite prevents the particles of scale from adhering to one another or to the boiler and they are thus easily removed.

The price increases with the grade of material, the best quality crystalline variety being quoted at present (f.o.b. New York) at 7½¢–8¢ per pound (Ceylon lumps).

The coarser flakes are necessary for crucibles, as they help to bind the clay together in addition to their refractory service. Imports in 1926 from Ceylon, Canada, Madagascar, Mexico and Korea, totaled 16,194 short tons valued at $923,513 compared with 17,780 tons valued at $828,082 in 1925.

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Occurrence of graphite has been reported at various times from Calaveras, Fresno, Imperial, Inyo, Los Angeles, Mendocino, San Bernardino, San Diego, Siskiyou, Sonoma and Tuolumne counties.

During 1925 there was a small commercial output of graphite from Inyo County. For several years a single plant in Los Angeles County was concentrating graphite from a disseminated ore, the product being used for paint and for foundry facing.

Graphite Production of California, by Years.

According to the records of the State Mining Bureau, the graphite production of California, by years, has been as follows:

Year	Pounds	Value
1901	128,000	$4,480
1902	84,000	1,680
1903		
1913	2,500	25
1914		
1915		
1916	29,190	2,335
1917		
1918		
1919	*770,000	37,225
1920		
1921		
1922	*624,000	26,160
1923	*	*
1925		
1926		
Totals	1,637,690	$71,905

* Annual details concealed under 'Unapportioned,' on account of a single producer.

GYPSUM.

Bibliography: State Mineralogist Reports XIV, XV, XVII, XVIII, XXII. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 223, 413, 430, 697. U. S. Bur. of Standards, Circular No. 281.

During 1926, one operator each in Imperial and Kern counties and two in Riverside produced a total of 114,868 tons of gypsum, valued at $211,337, compared with 107,613 tons and $172,444 in 1925. The material was utilized mainly in cement manufacture as a retardent, for hard-wall plaster (including wall board), and for fertilizer.

Uses.

The most important use of gypsum from the quantity standpoint is in the calcined form where it is utilized in the manufacture of various hard-wall plasters and plaster board. As plaster of paris, it plays a very important part in surgical work. Approximately 2%, by weight, raw gypsum is added in the manufacture of Portland cement just before the final grinding. In this application, the gypsum acts as a retarder to the set of the cement. The use of gypsum tile for non-bearing fireproof partitions, stairway and elevator enclosures, and the protection of steel columns, girders and beams, has increased greatly.

Keene's cement is a gypsum product, calcined to complete dehydration, and an accelerator added such as alum, potassium sulphate, borax, aluminum sulphate.

Land plaster may be applied to the soil by drilling, or scattered in the hill, or it may be sowed broadcast, in quantities ranging from 200 to 500 pounds to the acre.

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Total Production of Gypsum in California.

Production of gypsum annually in California since such records have been compiled by this Bureau is as follows:

Year	Tons	Value	Year	Tons	Value
1887	2,700	$27,000	1908	34,600	$155,400
1888	2,500	25,000	1909	30,700	138,176
1889	3,000	30,000	1910	45,294	129,152
1890	3,000	30,000	1911	31,457	101,475
1891	2,000	20,000	1912	37,529	117,388
1892	2,000	20,000	1913	47,100	135,050
1893	1,620	14,280	1914	29,734	78,375
1894	2,446	24,584	1915	20,200	48,953
1895	5,158	51,014	1916	33,384	59,533
1896	1,310	12,580	1917	30,825	56,840
1897	2,200	19,250	1918	19,695	37,176
1898	3,100	23,600	1919	19,813	50,579
1899	3,663	14,950	1920	20,507	92,535
1900	2,522	10,088	1921	37,412	78,875
1901	3,875	38,750	1922	47,084	188,336
1902	10,200	53,500	1923	86,410	289,136
1903	6,914	46,441	1924	25,569	53,210
1904	8,350	56,592	1925	107,613	172,444
1905	12,859	54,500	1926	114,868	211,377
1906	21,000	69,000			
1907	8,900	57,700	Totals	929,102	$2,892,799

INFUSORIAL and DIATOMACEOUS EARTH.

Bibliography: State Mineralogist Reports II, XII–XV (inc), XVII–XXII (inc.). Bulletins 38, 67, 91. Am. Inst. Min. Eng., Bull. 104, August, 1915, pp. 1539–1550. U. S. Bur. of Mines, Rep. of Investigations: Serial No. 2431, Jan., 1923. Eng. & Min. Jour.-Press, Vol. 115, pp. 1152–1154, June 30, 1923.

Infusorial and diatomaceous earths—sometimes called tripolite—are very light and extremely porous, chalk-like materials composed of pure silica (chalk, being calcareous) which have been laid down under water and consist of the remains of microscopical infusoria and diatoms. The former are animal remains, and the latter are from plants. The principal commercial use of this material is as an absorbent. It is also employed in the manufacture of scouring soap and polishing powders; for filtration purposes; in making some classes of refractory brick; and as an insulating medium both in heating and refrigeration. It is a first-class nonconductor of heat, where high temperatures are employed, such as around steel and gas plants and power houses. In such cases, it is built in as an insulating layer in furnace walls. In Germany, under the name 'kieselguhr,' it was used as an absorbent for nitroglycerine in the early manufacture of dynamite.

As a nonconductor of heat it has been used alone or with other materials as a covering for boilers, steam pipes and safes, and in fireproof cement. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass as well as in the manufacture of cement, tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard-rubber objects, matches, and paper maché, and for solidifying bromide. For making insulating brick the material is sawed into blocks, and for all other purposes it is ground and screened.

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The most important deposits in California thus far known are located in Monterey, Orange, San Luis Obispo, and Santa Barbara counties. The Santa Barbara material is diatomaceous and is of a superior quality, particularly for filtration uses which bring the higher prices. Infusorial or diatomaceous earths are also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma, and Tehama counties.

As over 90% of the output in California is from a single operator, we have concealed the exact figures under the 'Unapportioned' item in the state and county totals. There were six operators in 1926 in Monterey, Santa Barbara and Shasta counties, the shipments showing an increase in tonnage, but a decrease in total value compared with 1925.

The material shipped was utilized for insulation, filtration, paint pigment, cement admixture, and for clarification of gasoline and kerosene.

Total Production of Diatomaceous Earth in California.

The first recorded production of these materials in California occurred in 1889; total amount and value of output, to date, are as follows:

Year	Tons	Value	Year	Tons	Value
1889	39	$1,335	1909	500	$3,500
1890			1910	1,843	17,617
1891			1911	2,194	19,670
1892			1912	4,129	17,074
1893	50	2,000	1913	8,645	35,968
1894	51	2,040	1914	12,840	80,350
1895			1915	12,400	62,000
1896			1916	15,322	80,619
1897	5	200	1917	24,301	127,510
1898			1918	35,963	189,459
1899			1919	40,200	217,800
1900			1920	60,764	1,056,260
1901			1921		
1902	422	2,532	1922	*90,739	1,016,675
1903	2,703	16,015	1923		
1904	6,950	112,282	1924	*193,064	5,729,736
1905	3,000	15,000	1925		
1906	2,430	14,400	1926	*	*
1907	2,531	28,948			
1908	2,950	32,012	Totals	524,035	$8,881,032

*Annual details concealed under 'Unapportioned.'

LIMESTONE.

Bibliography: State Mineralogist Reports IV, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 38, 91. Oregon Agr. College, Extension Bulletin 305. Eng. and Min. Jour.-Press, Vol. 120, pp. 249–253.

'Industrial' limestone was produced in nine counties during 1926, to the amount of 108,795 tons, valued at $367,501, being a decrease both in quantity and value compared to the 1925 output of 319,977 tons, worth $494,525.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical

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and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. That from Santa Clara and Los Angeles counties is calcareous marl sold for agricultural purposes. Of the total product in 1926, approximately 17,000 tons, valued at $61,594 were used for agricultural purposes.

Distribution of the 1926 output was as follows:

County	*Tons*	*Value*
El Dorado	59,386	$186,702
San Bernardino	11,226	49,504
Tulare	18,000	70,000
Contra Costa, Inyo, Los Angeles, Santa Cruz, Shasta, Tuolumne, Ventura *	20,183	61,295
Totals	108,795	$367,501

* Combined to conceal output of a single operator in each.

Limestone Production of California, by Years.

The following tabulation gives the amounts and value of 'industrial' limestone produced in California by years since 1894 when compilation of such records was begun by the State Mining Bureau. These tonnages consist principally of limestone utilized for flux, glass and sugar making, agricultural, chemical, and other special industrial purposes. That utilized in cement manufacture is not included.

Year	Tons	Value	Year	Tons	Value
1894	15,420	$19,275	1912	613,375	$570,248
1895	71,355	71,690	1913	301,918	274,455
1896	68,184	71,112	1914	572,272	517,713
1897	36,796	38,556	1915	146,324	156,288
1898	27,686	24,548	1916	187,521	217,733
1899	30,769	29,185	1917	237,279	356,396
1900	32,791	31,532	1918	208,566	456,258
1901	76,937	99,445	1919	88,291	248,145
1902	71,422	90,524	1920	90,120	298,197
1903	125,919	163,988	1921	75,921	305,912
1904	40,207	87,207	1922	84,382	282,181
1905	192,749	323,325	1923	143,266	348,464
1906	80,262	162,827	1924	219,476	582,060
1907	230,985	406,041	1925	319,977	494,525
1908	273,890	297,264	1926	108,795	367,501
1909	337,676	419,921			
1910	681,635	581,208	Totals	6,311,564	$8,847,114
1911	516,398	452,790			

LITHIA.

Bibliography: State Mineralogist Reports II, IV, XIV, XXI, Bulletins 38, 67, 91.

Lithia mica, lepidolite (a silicate of lithium et al.) utilized in the manufacture of artificial mineral water, fireworks, glass, etc., has been mined in San Diego County since 1899, except between 1905 and 1915, though there was none shipped in 1923 and 1925. The 1926 figures are concealed under the 'Unapportioned' item. Some amblygonite, a lithium phosphate, is occasionally also obtained from pockets associated with the gem tourmalines.

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Lithia mica total production in the state has been as follows:

Year	Tons	Value	Year	Tons	Value
1896	124	$4,600	1918	4,111	$73,998
1900	440	11,000	1919	800	14,400
1901	1,100	27,500	1920	10,046	153,502
1902	822	31,880	1921	*1,365	20,781
1903	700	27,300	1922		
1904	641	25,000	1923		
1905	25	276	1924	109	2,269
1906			1925		
1915	91	1,365	1926	*	*
1916	71	1,065			
1917	880	8,800	Totals	21,325	$403,736

*Annual details concealed under 'Unapportioned.'

MICA.

Bibliography: State Mineralogist Reports II, IV. Bulletins 38, 67, 91. U. S. Geol. Surv., Bull. 740; Min. Res. of U. S. Eng. & Min. Jour.-Press, Vol. 115, pp. 55–60, Jan. 13, 1923.

No commercial production of mica has recently been reported in California. Production in previous years has been as follows:

Year	*Tons*	*Value*
1902	50	$2,500
1903	50	3,800
1904	50	3,000
Totals	150	$9,300

Classification and Uses.

Practically all marketable mica is of the muscovite or phlogopite varieties. There are three main commercial classes: Sheet mica, including punch; splittings, and scrap. Sheet mica is used chiefly for electrical purposes and for glazing; splittings are made into built-up mica; scrap is ground to a powder. Mica to be classified as sheet must yield a rectangle of at least 1½ x 2 in., must split evenly and freely, be free from cracks, rulings, or plications, and reasonably free from inclusions of foreign matter, though stains of a nonconducting character are permissible for some uses. Ability to withstand heat and high electrical resistance have led to a wide application of sheet mica in the electrical industries. The electrical uses of sheet mica greatly exceed all others in quantity and value of the material used.

As a heat-resisting transparent medium, sheet mica has various uses. It is widely employed for stove windows, though this use has declined to a considerable extent. A hard and rigid mica that is nearly clear is best suited for stove fronts. High-grade stove mica commands a higher price than electrical mica, because for the most part larger sizes are demanded. Mica is also used in furnace and bake-oven sight-holes, heat screens, lamp chimneys, canopies and shades, particularly for gas mantles, and also for military lanterns and in lantern slides.

Its ability to withstand shocks and strains, combined with its transparency, has led to wide use in motor goggles, spectacles, diver's helmets, smoke helmets, compass cards, gage fronts, and in windows subject to shock, as in the conning towers of warships. On account of its heat-resisting qualities, ground mica is used in railroad car axle

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packings, in pipe and boiler coverings, in fire-proof paints, and in rubber tires. Ground mica is used as a component in roofing, as a filler in rubber and other products, in calico printing, and as a tire powder. It is used also in tinsel decorations, and as 'Santa Claus snow' for Christmas tree and window decorations. It is used as a lubricant for wooden bearings, and mixed with oil for metal bearings.

MINERAL PAINT.

Bibliography: State Mineralogist Reports XII–XIX (inc.), XXI, XXII. Bulletins 38, 91.

Mineral paint materials were produced in California in 1926 from properties in Stanislaus County, amounting to 569 tons, valued at $5,846. This is a decrease from 669 tons and $6,969 of 1925 and was entirely of yellow ochre. Hematite has been shipped from Placer County, and red ochre from Sonoma and Ventura counties in former years.

Mineral Paint Production of California, by Years.

The first recorded production of mineral paint materials in the state was in the year 1890. The output, showing annual amount and value since that time, is given herewith:

Year	Tons	Value	Year	Tons	Value
1890	40	$480	1910	200	$2,040
1891	22	880	1911	186	1,184
1892	25	750	1912	300	1,800
1893	590	26,795	1913	303	1,780
1894	610	14,140	1914	132	847
1895	750	8,425	1915	311	1,756
1896	395	5,540	1916	643	3,960
1897	578	8,165	1917	520	2,700
1898	653	9,698	1918	728	4,738
1899	1,704	20,294	1919	1,780	17,055
1900	529	3,993	1920	779	8,477
1901	325	875	1921	446	4,748
1902	589	1,533	1922	1,620	13,277
1903	2,370	3,720	1923	1,049	11,773
1904	270	1,985	1924	532	5,234
1905	754	4,025	1925	669	6,969
1906	250	1,720	1926	569	5,846
1907	250	1,720			
1908	335	2,250	Totals	21,511	$206,697
1909	305	2,325			

MINERAL WATER.

Bibliography: State Mineralogist Reports VI, XII–XVIII (inc.), XXI–XXIII (inc.). U. S. G. S., Water Supply Paper 338. Min. Res. 1914, 1916. 'Mineral Springs and Health Resorts of California,' by Dr. Winslow Anderson, 1890. U. S. Dept. of Agr., Bur. of Chem., Bulletin 91.

A widespread production of mineral water is shown annually in California. These figures refer to mineral water actually bottled for sale, or for local consumption. Water from some of the springs having a special medicinal value brings a price many times higher than the

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average shown, while in some cases the water is used merely for drinking purposes and sells for a nominal figure. Health and pleasure resorts are located at many of the springs. The waters of some of the hot springs are not suitable for drinking, but are very efficacious for bathing.

From a therapeutic standpoint, California is particularly rich in mineral springs. The counterparts of many of the world-famed spas of Europe and the eastern United States can be found here. Radioactivity has been noted in at least two localities in California: At The Geysers in Sonoma County, and Arrowhead Hot Springs in San Bernardino County. It doubtless exists at others, but the State Mining Bureau has not as yet had funds available to conduct the necessary investigations along this line.

So far as the efficacy of radioactivity in mineral water is concerned, it has been found by investigations of the U. S. Geological Survey and the U. S. Department of Agriculture that it is not retained and transported in bottled water. Radioactivity in water is only temporary, and dissipates. To obtain whatever therapeutic effect it may possess, radioactive water should be utilized directly at the spring.

Commercial production of mineral water in California for 1926 amounted to a total of 14,074,877 gallons, valued at $1,171,550, being a new high record in quantity but slightly lower value than 1925. The 1926 output was distributed by counties, as follows:

County	*Gallons*	*Value*
Lake	57,000	$58,235
Los Angeles	4,026,465	200,459
Napa	80,376	49,468
San Diego	156,380	23,259
Sonoma	36,272	7,752
Butte, Calaveras, Contra Costa, Fresno, Marin, Riverside, San Benito, San Bernardino, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano, Trinity*	9,718,384	832,377
	14,074,877	**$1,171,550**

*Combined to conceal output of a single operator in each.

The production above tabulated was in part bottled with artificial carbonation, in part natural and a large part was used in the preparation of soft drinks with flavors.

Although some of the operators complain that prohibition has all but killed off the mineral water business, the reports of actual production of mineral water bottled and sold indicate an encouraging growth and a material increase annually both in total quantity and value, as may be noted from the tabulation below.

Mineral Water Production of California, by Years.

Mineral water was bottled for sale, at the Napa Soda Springs, Napa County, as early as 1860, and at other springs in California, notably The Geysers, Sonoma County, also at early dates; but there are no figures available earlier than the year 1887. Amounts and values, annually, since that year are shown herewith:

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Year	Gallons	Value	Year	Gallons	Value
1887	618,162	$144,368	1908	2,789,715	$560,507
1888	1,112,202	252,990	1909	2,449,834	465,488
1889	808,625	252,241	1910	2,335,259	522,909
1890	258,722	89,786	1911	2,637,669	590,654
1891	331,553	139,959	1912	2,497,794	529,384
1892	331,875	162,019	1913	2,350,792	599,748
1893	383,179	90,667	1914	2,443,572	476,169
1894	402,275	184,481	1915	2,274,267	467,738
1895	701,397	291,500	1916	2,273,817	410,112
1896	808,843	337,434	1917	1,942,020	340,566
1897	1,508,192	345,863	1918	1,808,791	375,650
1898	1,429,809	213,817	1919	2,233,842	340,117
1899	1,338,537	406,691	1920	2,391,791	421,643
1900	2,456,115	268,607	1921	3,446,278	367,476
1901	1,555,328	559,057	1922	4,276,316	486,424
1902	1,701,142	612,477	1923	5,487,276	616,919
1903	2,056,340	558,201	1924	8,159,211	818,726
1904	2,430,320	496,946	1925	12,115,072	1,230,455
1905	2,194,150	538,700	1926	14,074,877	1,171,550
1906	1,585,690	478,186			
1907	2,924,269	544,016	Totals	104,927,948	$17,759,340

PHOSPHATES.

Bibliography: State Mineralogist Report XXI. Bulletins 67, 91.

No commercial production of phosphates has been recorded from California, though occasional pockets of the lithium phosphate, amblygonite, Li (AlF) PO_4, have been found associated with the gem tourmaline deposits in San Diego County. Such production has been classified under lithia.

PUMICE and VOLCANIC ASH.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII. Bulletin 38 (See 'Tufa').

The production of pumice and volcanic ash for the year 1926 amounted to 7170 tons valued at $48,350, and came from properties in Imperial, Inyo, Kern, and Mono counties. This is an increase both in tonnage and value compared with the 1925 shipments which were 5319 tons worth $32,937.

The material from Imperial County and part of that from Mono is of the vesicular, block variety and was sold for abrasive purposes; the balance of the Mono material and that from Inyo and Kern was the volcanic ash, or tuff variety, and was employed in making soap and cleanser compounds. The Kern County ash is going into the preparation of one of the popular and nationally advertised brands of cleanser compounds.

Pumice Production of California, by Years.

Commercial production of pumice in California was first reported to the State Mining Bureau in 1909, then not again until 1912, since which year there has been a small annual output, as indicated by the following table:

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Year	Tons	Value	Year	Tons	Value
1909	50	$500	1919	2,388	$43,657
1910			1920	1,537	25,890
1911			1921	406	6,310
1912	100	2,500	1922	613	4,218
1913	3,590	4,500	1923	2,936	16,309
1914	50	1,000	1924	4,919	33,404
1915	380	6,400	1925	5,319	32,937
1916	1,246	18,092	1926	7,170	48,350
1917	525	5,295			
1918	2,114	28,669	Totals	33,343	$278,061

PYRITES.

Bibliography: State Mineralogist Reports XVIII, XIX, XXII. Bulletins 38, 91. Min. and Sci. Press, Vol. 114, pp. 825, 840.

A total production of 100,896 short tons of pyrites, valued at $466,088, was reported shipped in California during 1926 from properties in Alameda, Mariposa, and Shasta counties. This was a decrease both in tonnage and value from the figures of 129,500 tons and $528,550 in 1925.

The material was mostly used in the manufacture of sulphuric acid for explosives and fertilizers, but a portion was utilized directly in the preparation of agricultural fertilizer and insecticide. The sulphur content ranged up to 46.5% S.

This does not include the large quantities of pyrite, chalcopyrite, and *other* sulphides which are otherwise treated for their valuable metal contents. Some sulphuric acid is annually made as a by-product in the course of roasting certain tonnages of Mother Lode auriferous concentrates while under treatment for their precious metal values.

Pyrites Production in California, by Years.

The total recorded pyrites production in California to date is as follows:

Year	Tons	Value	Year	Tons	Value
1898	6,000	$30,000	1914	79,267	$230,058
1899	5,400	28,620	1915	92,462	293,148
1900	3,612	21,133	1916	120,525	372,969
1901	4,578	18,429	1917	111,325	323,704
1902	17,525	60,306	1918	128,329	425,012
1903	24,311	94,000	1919	147,024	540,300
1904	15,043	62,992	1920	146,001	530,581
1905	15,503	63,958	1921	110,025	473,735
1906	46,689	145,895	1922	151,381	570,425
1907	82,270	251,774	1923	148,004	555,308
1908	107,081	610,335	1924	124,214	517,835
1909	457,867	1,389,802	1925	129,500	528,550
1910	42,621	179,862	1926	100,896	466,088
1911	54,225	182,954			
1912	69,872	203,470	Totals	2,620,580	$9,389,830
1913	79,000	218,537			

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SHALE OIL.

Bibliography: State Mineralogist Report XIX. U. S. Geol. Surv., Bulletins 322, 729. U. S. Bur. of Mines, Bull. 210. Eng. and Min. Jour.-Press, Vol. 118, No. 8, pp. 290–292, Aug. 23, 1924. Chem. & Met. Eng., Vol. 32, No. 6, Feb., 1925. Min. Congress Jour., Dec., 1924.

Oil Shale is defined by Gavin,[1] as follows:

"Oil shale is a compact, laminated rock of sedimentary origin, yielding over 33 per cent of ash and containing organic matter that yields oil when distilled, but not appreciably when extracted with the ordinary solvents for petroleum.

* * * * * * *

"Oil shales contain a substance, or substances, usually classed as a pyro-bitumen, that by destructive distillation, or pyrolysis, yields oils somewhat similar to petroleum. These substances have been termed 'kerogen,' from two Greek words meaning producer of wax."

The Scottish oil shales are also known as 'torbanite.'

The so-called 'oil shales' of California do not for the most part conform to the above definition, as the greater part of the oil obtained from them occurs as such and can be extracted by suitable solvents. The most extensive deposits in this state are part of the Monterey formation of Tertiary age, and physically and chemically are different from the oil shales of Scotland and from other oil shales in the United States. The mineral matter of this shale is diatomaceous; the beds that yield oil occur in massive formation; and when freshly broken smell strongly of petroleum. Most geologists consider the Monterey shales to have been the origin of the oil in some of the oil fields of California.

Although the extraction of shale oil has been a matter of commercial practice on a considerable scale for many years in Scotland, France, and Australia, it has not attained any great commercial importance as yet in the United States. Technical knowledge of the subject, however, is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales of the United States will be an economic necessity. The selling price of petroleum will be the determining factor. The recovery of by-product ammonium sulphate is an important feature of the process.

Two plants on a more or less experimental scale have been in operation in California for several years past, with commercial production beginning in a small way in 1922. The product, in part, has been sold for utilization as a flotation oil in metallurgical work, and part has been consumed as fuel at the plants. As only one plant reported output for 1926, the value is concealed under the 'unapportioned' item.

Shale Oil Production of California, by Years.

Year	*Barrels*	*Value*
1922 } 1923 } *	4,333	$44,262
1924 } 1925 } *	8,688	55,240
1926	*	*
Totals	13,021	$99,502

* Annual details concealed under 'Unapportioned.'

[1] Gavin, M. J., Oil shale, an historical, technical, and economic study: U. S. Bur. of Mines, Bull. 210, p. 26, 1924.

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SILICA (Sand and Quartz).

Bibliography: State Mineralogist Reports IX, XIV, XV, XVII, XVIII, XX–XXIII. Bulletins 38, 67, 91.

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

A portion of the tonnage of vein quartz in California in 1916 and 1917 was employed in the preparation of ferro-silicon by the electric furnace. At present, some is utilized as a foundry flux, and for steel-casting molds. A portion of the silica sold (both sand and quartz) is also used in glazes for porcelain, pottery and tile, and in the body of the ware to diminish shrinkage; and some of the sand for the preparation of sodium silicate ('water glass'). Manufacturers of paint use finely ground silica, which forms as much as one-third of the total pigment in some paints. For certain purposes finely-ground crystalline material is superior in paints to other materials because of the angularity of the grains, which makes them adhere more firmly to the article painted and after wear afford a good surface for repainting. The same angularity makes artificially comminuted crystalline quartz superior to natural sand for use in wood fillers. It is also preferable for soaps and polishing powders. Part of the 1925 output was used for roofing and stucco-dash granules.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California in 1926 amounted to 30,010 tons, valued at $104,317, from eleven properties in seven counties.

Of the above total 11,729 tons was of sand and 18,281 tons of vein and boulder quartz. For making the higher grades of glass, most of the sand is imported from Belgium. Belgian sand has also displaced local material in the manufacture of sodium silicate ('water-glass'). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the state: Alameda, Amador, El Dorado, Los Angeles, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin, and Tulare, the chief centers being Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

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Total Silica Production of California.

Total silica production in California since the inception of the industry, in 1899, is shown below, being mainly sand:

Year	Tons	Value	Year	Tons	Value
1899	3,000	$3,500	1914	28,538	$22,688
1900	2,200	2,200	1915	28,904	34,322
1901	5,000	16,250	1916	20,880	48,908
1902	4,500	12,225	1917	19,376	41,166
1903	7,725	7,525	1918	23,257	88,930
1904	10,004	12,276	1919	18,659	101,600
1905	9,257	8,121	1920	25,324	96,793
1906	9,750	13,375	1921	10,569	49,179
1907	11,065	8,178	1922	9,874	31,016
1908	9,255	22,045	1923	7,964	30,420
1909	12,259	25,517	1924	6,808	35,006
1910	19,224	18,265	1925	12,498	96,780
1911	8,620	8,672	1926	30,010	104,317
1912	13,075	15,404			
1913	18,618	21,899	Totals	386,213	$976,577

SILLIMANITE—ANDALUSITE—CYANITE GROUP.

Bibliography: State Mineralogist Report XX. Bulletins 67, 91. Dana's Mineralogy. U. S. Geol. Surv., Prof. Paper 110. Eng. & Min. Jour.-Press, Vol. 120, pp. 91–94, 1925. Amer. Mineralogist, June, 1924.

Sillimanite and andalusite are both aluminum silicates (Al_2SiO_5), having the same composition and formula, but with slightly different physical characteristics. Though both crystallize in the orthorhombic system, their crystal habits are different: Andalusite being usually in coarse prismatic forms, the prisms nearly square in shape; also occurs massive, imperfectly columnar, and sometimes radiated and granular. Sillimanite commonly occurs in long, slender crystals, not distinctly terminated; prismatic faces striated and rounded; often in close parallel groups, passing into fibrous and columnar massive forms, sometimes radiating. Colors are similar. Hardness, andalusite 7.5, sillimanite 6–7. Andalusite is slightly lighter in specific gravity.

A massive deposite of andalusite, found in Dry Creek Canyon in the White Mountains of the Inyo Range, in Mono County, is being mined by the Champion Porcelain Company of Detroit, Michigan. The material is shipped East and utilized in the manufacture of porcelain for automobile spark plugs and for other high-tension electric insulators.

Cyanite is also an aluminum silicate (Al_2SiO_5), of the same chemical composition as andalusite and sillimanite, but crystallizing in the triclinic system. Occurs usually in long-bladed crystals, rarely terminated; hardness 5-7.25; gravity 3.56-3.67 (being heavier than the other two); color, blue. A deposit of cyanite, apparently in quantity, is being developed in Imperial County, near Ogilby, and shipments made to a refractory plant in Los Angeles.

Dumortierite, though differing somewhat in composition from the above, being a basic aluminum silicate ($4\ Al_2O_3.3\ SiO_2$), has proved similar in behavior in ceramic work so that it is now being mixed with andalusite for electrical porcelains. A deposit of this mineral in Nevada is being mined for that purpose. Occurrences of massive

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dumortierite are known in Imperial County in this state and there may yet be some commercial possibilities for them.

Total Sillimanite Group Production of California, by Years.

Year	Tons	Value
1922 1923 1924 *	4,584	$98,790
1925 1926 *	4,810	203,000
Totals	9,394	$301,790

* Annual details concealed under 'Unapportioned.'

SOAPSTONE and TALC.

Bibliography: State Mineralogist Reports XII, XIV, XV, XVII–XXIII. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California in 1926 amounted to 17,004 tons, valued at $255,645 compared with 15,465 tons, valued at $239,084, in 1925. Nearly 80 per cent of the product was high-grade talc from Inyo, San Bernardino and Shasta counties, which material was utilized mainly in toilet powders, paint, paper, and rubber manufacture, and some in ceramics. The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc is steadily replacing imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

Composition and Varieties.

Talc is hydrous magnesium silicate with the chemical formula $H_2Mg_3(SiO_3)_4$. It is also called soapstone and steatite. The term 'talc' properly includes all forms of the pure mineral, whereas 'steatite' denotes particularly the massive, compact variety, and 'soapstone' the impure, massive forms containing as low as 50% of talc. When pure, talc is soft, having a hardness of 1, but impurities increase the hardness up to 3 or 4. The color varies from pure white and silvery white through gray, green, apple green, to dark green, also yellow, brown, and reddish when impure. It is commonly compact or massive, or in fine granular aggregates, and often in foliated plates or in fibrous aggregates.

Uses.

Although the uses of talc and soapstone are many and varied, some of them are not in general well known nor fully developed; and although few of their uses can justly be considered essential in the sense that no substitutes can be used, there are several which are of great importance. The widest use of talc is in the powdered form, and the value depends upon color (whiteness), uniformity, fineness of grain, freedom from grit, 'slip,' and sometimes freedom from lime. The white varieties, free from grit and iron, low in lime, ground to 200-mesh and finer, are largely used as a filler for paper, rubber and paint, and the

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very highest grade as toilet powder. Ground talc is also used in dressing and coating cloth, in making soap, rope, twine, pipe-covering compounds, heavy lubricants, and polishes. Ground talc and soapstone are used for foundry facings, either alone or mixed with graphite and a coarser grade is used in the manufacture of asphalt-coated roofing felts and papers, both as a filler and as a surfacing. Massive close-grained talc, free from iron and grit, is cut into blanks and baked, forming the material used for gas tips and electrical insulation, commonly known as 'lava.' Its hardness, its resistance to heat, acids and alkalies, and its great dielectric strength make it very useful for electric insulation, and no satisfactory substitute for it has been found.

Massive varieties of talc, pyrophyllite, and high grades of soapstone are cut into slate pencils and steel-workers' crayons. 'French chalk' or 'tailor's chalk' is a soft, massive talc. In China, Japan and India, massive talc (steatite) is carved into grotesque images and other forms, and is often sold as imitation jade. Soapstone is cut into slabs of 1 and 2 inches in thickness and sold as griddles, footwarmers, and fireless-cooker stones, or fabricated into laundry sinks and tubs, laboratory-table tops, hoods, tanks and sinks, electric switchboards, and for other uses in which the properties of resistance to heat, acids, and alkalies, and electricity are essential.

Imports.

Foreign importations of high-grade white talc suitable for the manufacture of toilet powder have come mainly from Canada, Italy and France. Foreign producers have the benefit of cheap labor, and a low tariff import duty. In addition to these disadvantages, California operators have to contend with transcontinental freight rates to the eastern manufacturing centers. In 1926 importations totaled 24,346 short tons, valued at $563,799, compared with 20,990 tons, valued at $449,338, in 1925, according to the United States Bureau of Foreign and Domestic Commerce.

Talc Production of California, by Years.

Production was intermittent in the state up to 1912; but there has been a material growth since 1916, as shown in the following table:

Year	Tons	Value	Year	Tons	Value
1893	400	$17,750	1911		
1894			1912	1,750	7,350
1895	25	375	1913	1,350	6,150
1896			1914	1,000	4,500
1897			1915	1,663	14,750
1898			1916	1,703	9,831
1899			1917	5,267	45,279
1900			1918	11,760	85,534
1901	10	119	1919	8,764	115,091
1902	14	288	1920	11,327	221,362
1903	219	10,124	1921	8,752	130,078
1904	228	2,315	1922	13,378	197,186
1905	300	3,000	1923	17,439	252,661
1906			1924	16,179	242,770
1907			1925	15,465	230,084
1908	3	48	1926	17,004	255,645
1909	33	280			
1910	740	7,260	Totals	134,773	$1,868,830

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STRONTIUM.

Bibliography: Bulletins 67, 91. U. S. G. S., Bull. 540; 660–I.

There has been no production of strontium minerals in California since 1918, though in that year both celestite ($SrSO_4$), and the carbonate, strontianite ($SrCO_3$) were shipped. The first recorded commercial output of strontium minerals in California was in 1916. The occurrence of the carbonate is particularly interesting and valuable, as it appears to be the only considerable deposit of commercial importance so far opened up in the United States. Shipments reported as averaging 80% $SrCO_3$ have been made. The deposit is associated with deposits of barite, near Barstow, San Bernardino County. The carbonate has also been found in massive form near Shoshone, Inyo County. In addition to Imperial County, celestite is found near Calico and Ludlow, and in the Avawatz Mountains in San Bernardino County, but as yet undeveloped.

Production of strontium minerals in California, by years, has been as follows:

Year	Tons	Value
1916	57	$2,850
1917	3,050	37,000
1918	2,900	33,000
1919		
Totals	6,007	$72,850

The principal use for strontium in the United States is in the form of the nitrate in the manufacture of red flares, or Costen and Bengal lights and fireworks. It is imported mainly from Germany and England. In Germany and Russia, strontium in the form of the hydroxide is used in the manufacture of beet sugar. It is stated that strontia is more efficient and satisfactory in that process than lime, as it gives an additional recovery of 6% to 8%.

Of the two minerals, strontianite (carbonate) and celestite (sulphate), the carbonate is the more desirable as it is easier to convert to other salts; but it is scarcer. Celestite is found with limestone and sandstone and is sometimes associated with gypsum. Strontianite is also found with limestone, but associated with barite and calcite.

SULPHUR.

Bibliography: State Mineralogist Reports IV, XIII, XIV. Bulletins 38, 67, 91.

In 1923–1924 there was a small production of sulphur, from a single property in Kern County. It was ground, and utilized as a fertilizer and in dusting for mildew. This was the first commercial output of native sulphur in California for many years although this mineral has been found to some extent in Colusa, Imperial, Inyo, Kern, Lake, Sonoma, Tehama, and Ventura counties.

Sulphur was produced at the famous Sulphur Bank mine in Lake County, during the years 1865–1868 (inc.), totaling 941 tons, valued at $53,500; following which the property became more valuable for its

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quicksilver. The Elgin quicksilver mine, near Wilbur Springs, Colusa County, is a similar occurrence.

The principal sources in the United States are the stratified deposits in Louisiana and Texas, extraction being accomplished by a unique system of wells with steam pipes. It is stated that three large companies operating there are capable of producing more than 1,000,000 tons annually in excess of our normal consumption in the United States, which averages about 600,000 tons. The mines at Freeport, Texas, are in a peculiarly favorable location in that they are practically at tidewater.

Formerly considerable sulphur was imported from Italy and from Japan; but the situation is now reversed, so that in 1926, a total of 576,966 long tons, valued at $10,918,394, was exported from the United States, principally to Europe and Canada, also Australia and New Zealand.

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CHAPTER SIX.

SALINES.

Bibliography: State Mineralogist Reports III, XIV, XV, XVII–XXIII (inc.). Bulletin 24. Spurr and Wormser, "Marketing of Minerals." "Non-Metallic Minerals," by R. B. Ladoo. See also under each substance.

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, and in 1926 joined by bromine. The nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group shows an increase to $5,458,593 in 1926 over the 1925 figure of $4,386,736 as detailed in the following tabulation:

Substance	1925		1926		Increase+ Decrease—
	Tons	Value	Tons	Value	Value
Borates	46,124	$1,526,938	47,605	$1,625,298	$98,360+
Magnesium salts	4,221	132,553	4,881	124,470	8,083—
Potash	36,355	829,770	32,884	812,285	17,485—
Salt	284,068	949,826	311,761	1,124,978	175,152+
Soda	48,625	947,649	63,333	1,305,802	358,153+
Unapportioned				*465,760	465,760+
Total value		$4,386,736		$5,458,593	
Net increase					$1,071,857+

*Includes bromine and calcium chloride.

BORATES.

Bibliography: State Mineralogist Reports III, X, XII–XV (inc.), XVII–XXIII (inc.). Bulletins 24, 67, 91.

During 1926 there was produced in California a total of 84,101 tons of borate materials compared with 79,865 tons for the year 1925. The materials shipped in 1926 included crude and selected colemanite ore from Inyo County varying from 19% to 30% anhydrous boric acid ("A.B.A."), also crystallized borax prepared by evaporation of brines at Searles Lake in San Bernardino County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40% A.B.A. This is approximately the average A.B.A. content of the colemanite material after calcining, and also of the crystallized borax obtained from evaporation of the lake brines.

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Recalculated as above, the 1926 production totals 47,605 tons, valued at $1,625,298, a slight increase over the similar figures for 1925 which were 46,124 tons and $1,526,938.

Colemanite is a calcium borate, and the material mined is shipped to seaboard chemical plants for refining. The latest development in the borax industry is the finding in quantity and opening up of a new borate mineral which bids fair to supplant colemanite in much the same way that the colemanite deposits displaced the borax industry in the desert playas or dry lakes, some forty years ago. This new mineral is 'kernite' (or 'rasorite'), a sodium borate with a smaller water-of-crystallization content than the 'borax' of commerce, so that when re-crystallized to borax, the resulting product has an increased weight over the original material. These deposits are being opened up by the Pacific Coast Borax Company in southeastern Kern County.

Refined 'borax' (sodium tetraborate) is used in making the enameled coating for cast-iron and steelware employed in plumbing fixtures, chemical equipment, and kitchen utensils. It is also a constituent of borosilicate glasses which are utilized in making lamp chimneys, baking dishes, and laboratory glassware. Other important uses of borax are in the manufacture of laundry and kitchen soaps, in starch, paper sizing, tanning, welding, and in the preparation of boric acid, which is employed as an antiseptic and in preserving meats. Among the newer uses for borax is its employment in the preserving of citrus fruits by washing them in a solution of borax, which closes the pores of the skin. The application of this process is increasing in California and Florida. Another is as a preservative of wood, in addition to which borax, being non-inflammable, renders it fireproof.

Total Production of Borate Materials in California.

Borax was first discovered in California in the waters of Tuscan Springs in Tehama County, January 8, 1856. Borax Lake in Lake County was discovered in September of the same year by Dr. John A. Veach. This deposit was worked in 1864–1868, inclusive, and during that time produced 1,181,365 pounds of refined borax. The bulk of it was exported by sea, to New York. This was the first commercial output of this salt in the United States, and California is still today the leading American producer of borax, having been for many years the sole producer.

Production from the dry lake 'playa' deposits of Inyo and San Bernardino counties began in 1873; but it was not until 1887 that the borax industry was revolutionized by the discovery of the colemanite beds at Calico, in San Bernardino County, and later similar beds in Inyo and Los Angeles counties. The colemanite deposits of Ventura County are at present unworked, owing to lack of transportation facilities. Some production of colemanite has been made from deposits opened up in Clarke County, Nevada.

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The total production of borate materials in California is shown in the following table:

Year	Tons	Value	Year	Tons	Value
1864			1897	8,000	$1,080,000
1865	12	$9,478	1898	8,300	1,153,000
1866	126	94,099	1899	20,357	1,139,882
1867	201	132,538	1900	25,837	1,013,251
1868	220	156,137	1901	22,221	982,380
1869	32	22,384	1902	[a]17,202	2,234,994
1870			1903	34,430	661,400
1871			1904	45,647	698,810
1872			1905	46,334	1,019,158
1873	140	89,600	1906	58,173	1,182,410
1874	515	255,440	1907	53,413	1,200,913
1875	915	259,427	1908	22,200	1,117,000
1876	1,168	289,080	1909	16,628	1,163,960
1877	1,437	312,537	1910	16,828	1,177,960
1878	993	193,705	1911	50,945	1,456,672
1879	373	66,257	1912	42,135	1,122,713
1880	364	65,443	1913	58,051	1,491,530
1881	609	149,245	1914	62,500	1,483,500
1882	690	189,750	1915	67,004	1,663,521
1883	732	201,300	1916	103,523	2,409,375
1884	900	265,500	1917	109,944	2,561,958
1885	1,019	198,705	1918	88,772	1,867,908
1886	942	155,430	1919	66,791	1,717,192
1887	1,285	173,475	1920	127,065	2,794,206
1888	1,015	116,689	1921	50,136	1,096,326
1889	1,405	196,636	1922	[b]39,087	1,068,025
1890	965	145,473	1923	62,667	1,893,798
1891	3,201	480,152	1924	52,070	1,599,149
1892	4,267	640,000	1925	46,124	1,526,938
1893	5,525	838,787	1926	47,605	1,625,298
1894	3,955	593,292			
1895	5,770	807,807			
1896	5,959	595,900	Totals	1,521,478	$51,572,893
	6,754	675,400			

[a] Refined borax. [b] Recalculated to 40% 'anhydrous boric acid' equivalent beginning with 1922.

BROMINE.

During 1926, commercial production of bromine and bromine compounds was begun by the California Chemical Corporation in its plant at Chula Vista, San Diego County, from salt-works bittern waters. This same plant has been recovering magnesium chloride for a number of years. A small amount of bromine was also reported made at the similar bittern-water plant of the Industrial Chemical Company at Newark, Alameda County. The amount and value of this first year's yield of bromine in California is concealed under the 'Unapportioned' item.

A large part of the bromine output of the United States is not sold as bromine, but in the form of potassium and sodium bromides and other salts. The principal production in the United States has come from bitterns from salt wells in Michigan, Ohio and West Virginia.

The best-known use of bromine is its application in the form of silver bromide in photography. Bromine, as such, was used extensively in the European War in making asphyxiating gases. It also has some uses in medicine, particularly in the treatment of nervous diseases.

CALCIUM CHLORIDE.

Bibliography: U. S. Geol. Surv., Min. Res. 1919, Pt. II. Engineering and Contracting, Roads & Streets monthly issue, Feb. 6, 1924. 'How to Maintain Roads,' manual of instruction of Dow Chemical Company.

Calcium chloride is hygroscopic, that is, it has an affinity for water.

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This property is taken advantage of by utilizing this salt as a drying agent. It is also sprinkled on dirt roads and playgrounds to keep down dust by absorbing moisture. In refrigerating machinery for ice factories, meat-packing houses and cold-storage warehouses, a calcium-chloride solution is stated to have some advantages over salt brine. In fire buckets this solution has an advantage over pure water, in that it has a lower freezing point, does not corrode metal, and tends to keep the buckets full due to its absorbing moisture from the atmosphere. Powdered calcium chloride is used in drying gases, fruits and vegetables.

For dust prevention on roads, it is stated that the flake form of the chloride gives better results than the granulated. Excellent results are reported with the following kinds of road surfaces: gravel, water-bound gravel, water-bound macadam, sand-clay, clay-sand, cinders, mine tailings. It can not be used to advantage on roads of heavy clay, oil-treated surfaces, heavy rolling sand, or the ordinary dirt road which is composed almost entirely of fine dead material. The last named should first have a resurfacing or application of gravel.

A very important and growing use for calcium chloride is its application to curing concrete pavements instead of the slower and more expensive earth and water-covering method. It is stated that one application of the flake chloride will absorb a sufficient amount of moisture from the air to keep the pavements wet continuously 24 hours per day when properly applied. There is no need of applying an earth covering and hence no subsequent earth removal, and no extra water pumping, thereby eliminating these items of expense. Not only that, but experience has proved that the time of set for the concrete is shortened by use of the chloride, so that pavements so treated can be opened to traffic in one-half the time required if cured by ponding or by earth and water. In the case of patching broken pavements, if calcium chloride is mixed in with the concrete as laid, in proper proportions, and a further application spread on the finished surface, the patched pavement can be opened to traffic in 48 hours without injury to the concrete.

Total Calcium Chloride Production of California.

Commercial production of calcium chloride in California was first reported to the State Mining Bureau in 1921, from two plants in San Bernardino County, being obtained as a by-product in the refining of salt from deposits in certain of the desert dry lakes. In 1922–1924, there was only a single operator, so that the annual details are concealed under the 'unapportioned' item.

Year	*Tons*	*Value*
1921	683	$22,980
1922 } *		
1923 }	1,204	26,580
1924 } *		
1925 }	10,988	328,876
1926	*	*
Totals	12,875	$378,436

* Annual details concealed under 'Unapportioned.'

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MAGNESIUM SALTS.

Bibliography: State Mineralogist Reports XX, XXI. Bulletin 91. 'Dictionary of Applied Chemistry,' by Thorpe. U. S. Geol. Surv., Min. Res. of U. S.

The production of magnesium chloride and sulphate in California during 1926 totaled 4881 tons, valued at $124,470, a slight increase in quantity but lower value from the 1925 figures of 4221 tons and $132,553. This was nearly all chloride, sold for use in magnesite stucco and cement mixtures (Sorel cement), also some for 'road liquor.' It was in part marketed in the liquid form testing 34°–36° Baumé, and in part as dry crystals, and was prepared from residual bitterns at salt plants in Alameda, San Diego, and San Mateo counties. The sulphate marketed was utilized for medicinal and bath purposes.

With the use of magnesite cement and stucco coming more into prominence in building construction on the Pacific Coast, the demand for magnesium chloride is increasing here; but the domestic article has to meet the competition of the cheaper, imported German chloride.

The average value reported for the chloride produced in California in 1926 was approximately $25.50 per ton, f.o.b. plant.

Total Production of Magnesium Salts in California.

Commercial production of magnesium chloride in California was begun in 1916 by some of the salt companies, from the residual bitterns obtained during the evaporation of sea water for its sodium chloride. In addition, some magnesium sulphate, or 'epsom salts' is also made, annually, but in smaller amount.

The total production of magnesium salts in California, since the beginning of the industry here, is shown in the following tabulation:

Year	Tons	Value
1916	851	$6,407
1917	1,064	34,973
1918	1,008	29,955
1919	1,616	82,457
1920	3,150	107,787
1921	4,153	106,140
1922	3,036	89,788
1923	3,662	116,031
1924	4,823	145,883
1925	4,221	132,553
1926	4,881	124,470
Totals	32,465	$976,444

NITRATES.

Bibliography: State Mineralogist Report XV. Bulletins 24, 67, 91. U. S. G. S., Press Bulletin No. 373, July, 1918. Smithsonian Inst., Publ. No. 2421, 1916.

Nitrates of sodium, potassium and calcium have been found in various places in the desert regions of the state, but no deposit of commercial value has been developed as yet. It is hoped that a closer search may some day be rewarded by workable discoveries. At present the principal commercial source of nitrates is the Chilean saltpeter (sodium nitrate) deposits in South America.

The fixation of atmospheric nitrogen electrically has been accomplished successfully in Germany and Scandinavia. The possibilities of

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cheap hydro-electric power in California make the subject one of interest to us, as we have also the natural raw materials and chemicals to go with the power. Sodium and potassium cyanides can be made by fixation of atmospheric nitrogen electrically.

POTASH.

Bibliography: State Mineralogist Reports XV, XVIII, XX, XXII. Bulletins 24, 67, 91. U. S. G. S., Min. Res. 1913, 1914, 1915. Senate Doc. No. 190, 62d Congress, 2d Session. Mining & Sci. Press, Vol. 112, p. 155; Vol. 114, p. 789. Eng. & Min. Jour.-Press, Vol. 117, p. 557, Apr. 5, 1924.

During 1926, a total of 32,884 tons of potash salts of all grades was produced in California, valued at $812,285, compared with 36,355 tons and $829,770 in 1925. This was in part chloride and part from distillery slops char. The quality of the product varied from 14% to 58% equivalent K_2O content; and the material was sold principally for fertilizer manufacture.

Imports of crude potash minerals and salts into the United States in 1926, according to the U. S. Bureau of Foreign & Domestic Commerce, amounted to 815,715 long tons, valued at $14,133,079, compared with 820,637 tons and $13,050,908 in 1925. These materials consisted mainly of 'manure salts,' crude chloride (muriate) and sulphate, and kainite, all of which are admitted duty-free.

Quotations have recently ranged from $46 per ton c.i.f. Atlantic and Gulf ports, for high-grade sulphate (90%–95%), to $35 per ton for muriate (80%–85%), and $19 for manure salts (30%).

Other uses for potash salts, besides those noted above, are in the manufacture of the best liquid soap and some higher-grade cake soaps, of some finer grades of glass, and in matches. The chemical requirements include tanning, dyeing, metallurgy, electroplating, photography and medicine.

Total Production of Potash in California.

Potash production began commercially in California in 1914, with a small yield from kelp. The bulk of the output comes from deposits of potash-bearing residues and brines in the old lake beds of the desert regions, particularly Searles Lake, San Bernardino County. A small amount is made annually from salt-works bitterns, and for a time there was some from Portland cement dust. Some also is obtained from molasses distillery-slops char.

The annual amounts and value of these potash materials, since their beginning in California in 1914, are shown by the following table:

Year	*Tons*	*Value*
1914	10	$460
1915	1,076	19,391
1916	17,908	663,605
1917	129,022	4,202,889
1918	49,381	6,808,976
1919	28,118	2,415,963
1920	26,298	1,465,463
1921	14,806	390,210
1922	17,776	584,388
1923	29,597	709,836
1924	33,107	747,407
1925	36,355	829,770
1926	32,884	812,285
Totals	416,338	$19,656,643

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SALT.

Bibliography: State Mineralogist Reports II, XII–XV (inc.), XVII–XXIII (inc.); Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 669. U. S. Bur. of Mines, Bull. 146.

Most of the salt production in California is obtained by evaporating the water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions, mainly in Kern and San Bernardino counties. A small amount of valuable medicinal salts is obtained by evaporation of the water of Lake Mono, Mono County.

Distribution of the 1926 salt production of California, by counties, was as follows:

Salt Production, by Counties, 1926.

County	*Tons*	*Value*
Alameda	202,777	$628,470
Kern	11,279	41,116
San Bernardino	22,522	85,463
Inyo, Los Angeles, Modoc, Mono,[a] Monterey, San Diego, San Mateo[b]	75,183	369,929
Totals	311,761	$1,124,978

[a] Medicinal salts.
[b] Combined to conceal output of a single operator in each.

The above returns show an increase both in tonnage and value over the figures of 1925 which were 284,068 tons and $949,826, though slightly below the record of 1924. There were seven plants operating in Alameda County in 1926, and a total of eleven in the other counties tabulated.

Production of Salt in California, by Years.

Amount and value of annual production of salt in California from 1887 is shown in the following tabulation:

Year	Tons	Value	Year	Tons	Value
1887	28,000	$112,000	1908	121,764	$281,469
1888	30,800	92,400	1909	155,680	414,708
1889	21,000	63,000	1910	174,920	395,417
1890	8,729	57,085	1911	173,332	324,255
1891	20,094	90,303	1912	185,721	383,370
1892	23,570	104,788	1913	204,407	462,681
1893	50,500	213,000	1914	223,806	582,553
1894	49,131	140,087	1915	169,028	368,737
1895	53,031	150,576	1916	186,148	455,695
1896	64,743	153,244	1917	227,825	581,373
1897	67,851	157,520	1918	212,076	806,328
1898	93,421	170,855	1919	233,994	896,963
1899	82,654	149,588	1920	230,638	972,648
1900	89,338	204,754	1921	197,989	832,702
1901	126,218	366,276	1922	223,238	819,187
1902	115,208	205,876	1923	275,979	1,130,670
1903	102,895	211,365	1924	318,800	1,159,137
1904	95,968	187,300	1925	284,068	949,826
1905	77,118	141,925	1926	311,761	1,124,978
1906	101,650	213,228			
1907	88,063	310,967	Totals	5,501,156	$16,412,934

SODA.

Bibliography: State Mineralogist Reports XII, XIII, XV, XVII, XVIII, XX; Bulletins 24, 67, 91. U. S. Geol. Surv., Bull. 717.

The production of sodium salts in California in 1926 included: soda

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ash, caustic soda and bicarbonate from plants at Owens Lake, Inyo County: trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, San Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County, in 1926. The total amounted to 63,333 tons, valued at $1,305,802, being an increase in both quantity and value compared with the 1925 figures of 48,625 tons and $947,649.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, and chemicals; and the trona for metallurgical purposes.

Sodium compounds to some extent replace potassium compounds, in glass and soap making, in photography, in match making, in tanning, and in the manufacture of cyanide for extracting gold and silver from their ores.

Soda Production of California, by Years.

The total output, showing amount and value of these materials in California since the inception of the statistical records of the State Mining Bureau, is given in the table which follows:

Year	Tons	Value	Year	Tons	Value
1894	1,530	$20,000	1912	7,200	$37,094
1895	1,900	47,500	1913	1,861	24,936
1896	3,000	65,000	1914	6,522	115,396
1897	5,000	110,000	1915	5,799	83,485
1898	7,000	154,000	1916	10,593	264,825
1899	10,000	250,000	1917	24,505	928,578
1900	1,000	50,000	1918	20,447	855,423
1901	8,000	400,000	1919	21,294	721,958
1902	7,000	50,000	1920	32,407	1,164,898
1903	18,000	27,000	1921	14,828	438,996
1904	12,000	18,000	1922	20,084	573,661
1905	15,000	22,500	1923	34,885	764,284
1906	12,000	18,000	1924	32,536	711,796
1907	----------	----------	1925	48,625	947,649
1908	9,600	14,400	1926	63,333	1,305,802
1909	7,712	11,593			
1910	8,125	11,862	Totals	480,809	$10,261,523
1911	9,023	52,887			

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CHAPTER SEVEN.

BY COUNTIES.

Introductory.

The State of California includes a total area of 158,297 square miles, of which 155,652 square miles are of land. The maximum width is 235 miles, the minimum 148 miles, and the length from the northwest corner to the southeast corner is 775 miles. The state is divided into fifty-eight counties. The 1920 census figures show a total population for California of 3,437,709. A 1926 estimate by the State Controller places the figure that year at 5,246,729. Minerals of commercial value exist in every county, and during 1926 some active production was reported to the State Mining Bureau from all of the fifty-eight.

Rank of Counties in Mineral Yield, 1926.

Of the first ten counties, in point of total output for 1926, the first four, Los Angeles, Kern, Orange, Ventura, owe their position mainly to petroleum, as does also Fresno (sixth). Los Angeles, due to its oil, leads all the others, being credited with 43% of the entire state's total value for 1926, having passed Kern in 1923, which led for many years. San Bernardino (fifth) owes its place chiefly to cement, silver, potash, borax, mineral water, and tungsten; Riverside (seventh) to cement, stone, brick and tile; Plumas to copper; Santa Cruz to cement; Nevada to gold. Twenty-four counties have each a total in excess of a million dollars for 1926. Cement is an important item in nine of these counties, gold in five, and magnesite in one. In point of variety and diversity, San Bernardino County led all the others in 1926, with a total of 24 different mineral products on its commercial list, followed by San Diego with 21; by Riverside with 18; Inyo, 17; Los Angeles and Shasta, 16 each; Kern, 14; Orange and Tuolumne, 13 each; Butte, Calaveras, Monterey, Santa Barbara, 12 each; Fresno, 11; Amador, Imperial, Placer, Sacramento, San Benito, Siskiyou, 10 each. The counties with their mineral resources, production for 1926, etc., are considered in detail in the following paragraphs.

	County	*Value*		*County*	*Value*
1.	Los Angeles	$194,358,926	31.	Siskiyou	$494,151
2.	Kern	83,556,074	32.	Placer	480,882
3.	Orange	63,223,082	33.	Imperial	467,314
4.	Ventura	30,208,369	34.	Butte	461,945
5.	San Bernardino	14,218,475	35.	Madera	425,738
6.	Fresno	6,699,928	36.	Stanislaus	401,997
7.	Riverside	6,194,253	37.	Tulare	397,920
8.	Plumas	3,572,628	38.	Monterey	359,993
9.	Santa Cruz	3,504,194	39.	Napa	341,571
10.	Nevada	3,240,211	40.	Mariposa	319,724
11.	Alameda	3,158,474	41.	El Dorado	302,086
12.	Yuba	2,921,083	42.	San Luis Obispo	253,294
13.	Shasta	2,886,144	43.	Sonoma	222,586
14.	Inyo	2,835,834	44.	Mono	209,848
15.	Santa Barbara	2,583,548	45.	Merced	192,665
16.	Contra Costa	2,610,553	46.	San Francisco	112,193
17.	Amador	2,451,500	47.	Colusa	91,194
18.	San Benito	2,400,850	48.	Lake	75,692
19.	Sacramento	2,243,952	49.	Del Norte	70,464
20.	San Mateo	1,893,853	50.	Glenn	58,391
21.	Calaveras	1,809,772	51.	Modoc	37,991
22.	Solano	1,770,820	52.	Yolo	20,560
23.	San Diego	1,241,324	53.	Lassen	19,063
24.	Santa Clara	1,028,506	54.	Mendocino	15,800
25.	San Joaquin	842,000	55.	Tehama	10,340
26.	Humboldt	706,670	56.	Kings	720
27.	Tuolumne	615,998	57.	Alpine	450
28.	Trinity	611,797	58.	Sutter	397
29.	Sierra	569,515			
30.	Marin	527,553		Total value	$450,330,856

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ALAMEDA.

Land area: 732 square miles.
Population: 344,177 (1920 census).
Location: East side of San Francisco Bay.

Alameda County, while in no sense one of the 'mining counties,' comes eleventh on the list with a value of mineral products for 1926 of $3,158,474, an increase over the 1925 total, which was $2,916,506. The mineral resources of this county include asbestos, brick, chromite, clay, coal, limestone, magnesite, manganese, potash, pyrite, salt, soapstone and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$808,779
Clay (pottery)	5,870 tons	7,183
Magnesium salts	916 tons	28,035
Salt	202,777 tons	628,470
Stone, miscellaneous	------	1,642,618
Other minerals *	------	43,389
Total value		$3,158,474

* Includes bromine and pyrites.

ALPINE.

Land area: 776 square miles.
Population: 243 (1920 census).
Location: On eastern border of state, south of Lake Tahoe.

Alpine has at times in the past shown a small production mainly of gold and silver. For 1926 the total value was $450 being mainly miscellaneous stone.

This county lies just south of Lake Tahoe, in the high Sierra Nevada. Transportation is by auto, wagon, or mule back, and facilities in general are lacking to promote development work.

The mineral resources of this section are varied and the country has not yet been thoroughly prospected. Occurrences of barium, copper, gold, gypsum, lead, limestone, pyrite, rose quartz, silver, tourmaline, and zinc have been noted here.

AMADOR.

Land area: 601 square miles.
Population: 7793 (1920 census).
Location: East-central part of state—Mother Lode district.

The value of Amador County's mineral production decreased from $2,625,703 in 1925 to $2,451,500, placing it number seventeen on the list of counties in the state as regards total value of mineral substances marketed. The decrease was due mainly to gold.

Although having an output consisting of 10 different minerals, the leading product, gold, makes up approximately 78% of the total value for the year.

Amador at one time led the state in gold production, though exceeded in 1920–1923 and in 1926 by Yuba and Nevada counties, but in 1925 by Yuba County only.

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The mineral resources of this county include asbestos, brick, chromite, clay, coal, copper, gold, limestone, quartz crystals, glass-sand, sandstone, silver, soapstone, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and clay	-----	$237,792
Gold	-----	2,167,275
Lead	1,267 lbs.	101
Silver	21,510 fine oz.	13,422
Stone, miscellaneous	-----	24,900
Other minerals *	-----	8,010
Total value		$2,451,500

* Includes coal, copper, marble.

BUTTE.

Land area: 1722 square miles.
Population: 30,030 (1920 census).
Location: North-central portion of state.

Butte, thirty-fourth county in California in regard to the value of its mineral output, reported a commercial production of twelve mineral substances, having a total value of $461,945, as compared with $546,178 in 1925. As will be noted in the following tabulation, gold is by far the most important item. Butte stands eighth among the gold-producing counties of the state. Among the mineral resources of this section are asbestos, barytes, chromite, gems, gold, limestone, marble, mineral water, platinum group, silver and miscellaneous stone.

Commercial value for 1926 was as follows:

Substance	*Amount*	*Value*
Brick	273 M.	$4,316
Gems (diamonds)	----	175
Gold	----	287,853
Platinum	10 fine oz.	954
Silver	4,803 fine oz.	2,997
Stone, miscellaneous	----	147,604
Other minerals *	----	18,046
Total value		$461,945

* Includes clay (pottery), mineral water, natural gas, soapstone.

CALAVERAS.

Land area: 1027 square miles.
Population: 6183 (1920 census).
Location: East-central portion of state—Mother Lode district.

Calaveras County reported production of twelve different minerals, valued at $1,809,772, during the year 1926, as compared with the 1925 output of $1,450,618. Copper, gold, cement and stone are the chief mineral substances. In regard to total value of mineral output, Calaveras stands twenty-first among the counties of the state, for 1926, and fifth in gold.

The principal mineral resources developed and undeveloped are: Asbestos, chromite, clay, copper, fuller's earth, gold, limestone, marble, mineral paint, mineral water, platinum group, pyrite, quartz crystals, silver, soapstone, and miscellaneous stone.

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Commercial output for 1926 was as follows:

Substance	*Amount*	*Value*
Copper	5,240,927	$733,730
Gold		576,889
Silver	9,983 fine oz.	6,229
Stone, miscellaneous		59,000
Other minerals *		433,924
Total value		$1,809,772

* Includes cement, pottery clay, gems (quartz crystals), lead, mineral water, soapstone.

COLUSA.

Land area: 1140 square miles.
Population: 9920 (1920 census).
Location: Sacramento Valley.

Colusa County lies largely in the basin of the Sacramento Valley. Its western border, however, rises into the foothills of the Coast Range of mountains, and its mineral resources—largely undeveloped—include coal, chromite, copper, gypsum, manganese, mineral water, pyrite, quicksilver, sandstone, miscellaneous stone, sulphur, and in some places traces of gold and silver.

The value of the 1926 production was $91,194, a decrease from the 1925 figures of $103,230, giving it forty-seventh place, and was as follows:

Substance	*Value*
Stone, miscellaneous	$75,167
Unapportioned	16,027
Total value	$91,194

CONTRA COSTA.

Land area: 714 square miles.
Population: 53,889 (1920 census).
Location: East side of San Francisco Bay.

Contra Costa, like Alameda County, lies on the eastern shore of San Francisco Bay, and is not commonly considered among the mineral producing counties of the state. It stands sixteenth on the list in this respect, however, with an output valued at $2,610,553 for the calendar year 1926. Various structural materials make up the chief items, including brick, cement, limestone, and miscellaneous stone. Among the others are asbestos, clay, coal, gypsum, manganese, mineral water, and soapstone.

Commercial production for 1926 was as follows:

Substance	*Value*
Clay and clay products	$448,584
Stone, miscellaneous	766,921
Other minerals *	1,395,048
Total value	$2,610,553

* Includes cement, limestone, mineral water.

DEL NORTE.

Land area: 1024 square miles.
Population: 2759 (1920 census).
Location: Extreme northwest corner of state.

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Transportation: Motor, wagon and mule back; steamer from Crescent City.

Del Norte almost rivals Alpine County in regard to inaccessibility. Like the latter county also, given transportation and kindred facilities, this portion of the state presents a field for development along mining lines especially. Its chief mineral resources, largely untouched, are chromite, copper, gems, gold, iron, platinum group, silver, and miscellaneous stone.

The 1926 output was a decrease from the figure of $270,582 in 1925, the principal item of which is crushed rock used on highway construction, and rock used on the Crescent City harbor jetty.

Commercial production for 1926, giving it forty-ninth place, was as follows:

Substance	*Amount*	*Value*
Gold	--	$1,078
Platinum	10 fine oz.	1,132
Silver	6 fine oz.	4
Stone, miscellaneous	--	68,250
Total value		$70,464

EL DORADO.

Land area: 1753 square miles.
Population: 6426 (1920 census).
Location: East-central portion of the state, northernmost of the Mother Lode counties.

El Dorado County, which contains the locality where gold in California was first heralded to the world, comes forty-first on the list of counties ranked according to the value of their total mineral production during the year 1926. In addition to the segregated figures here given, a large tonnage of limestone is annually shipped from El Dorado for use in cement manufacture, and whose value is included in the state total for cement. The decrease from the 1925 figure of $352,828 was due to limestone.

The mineral resources of this section, many of them undeveloped, include asbestos, barytes, chromite, clay, copper, gems, gold, iron, molybdenum, limestone, quartz crystals, quicksilver, slate, soapstone, silver, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$91,789
Limestone	59,386 tons	186,702
Silver	756 fine oz.	472
Stone, miscellaneous	-----	17,510
Other minerals *	-----	5,613
Total value		$302,086

* Includes lime, silica, slate

FRESNO.

Land area: 5950 square miles.
Population: 128,779 (1920 census).
Location: South-central portion of state.

Fresno County, sixth in importance as a mineral producer among the counties of California, reported an output for 1926 of eleven mineral

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substances with a total value of $6,699,928, a decrease from the reported 1925 production, which was worth $9,264,996.

The bulk of the above is derived from the petroleum production of the Coalinga field, with miscellaneous stone also important.

The mineral resources of this county are many, and, aside from crude oil, are in the main not fully developed. They include asbestos, barytes, brick, chromite, copper, gems, gold, graphite, gypsum, magnesite, natural gas, petroleum, quicksilver, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*		*Value*
Brick and hollow building tile	--------		$87,493
Gold	--------		8,595
Granite	17,880	cu. ft.	78,624
Natural gas	1,920,489	M cu. ft.	153,726
Petroleum	7,340,102	bbls.	5,982,183
Silver	84	fine oz.	52
Stone, miscellaneous	--------		388,555
Other minerals	--------		800
Total value			$6,699,928

GLENN.

Land area: 1259 square miles.
Population: 11,853 (1920 census).
Location: West side of Sacramento Valley.

Glenn County, standing fiftieth, owes its position among the mineral-producing counties of the state mainly to the presence of large deposits of sand and gravel which are annually worked, the product being used for railroad ballast, etc. In 1917 and 1918, chromite was also an important item. In the foothills in the western portion of the county, deposits of chromite, copper, manganese, sandstone, and soapstone have been found.

Commercial production for 1926 was as follows, being a decrease from the $92,288 of the previous year:

Substance	*Value*
Stone, miscellaneous	$58,391

HUMBOLDT.

Land area: 3634 square miles.
Population: 37,857 (1920 census).
Location: Northwestern portion of state, bordering on Pacific Ocean.

Humboldt County is almost entirely mountainous, transportation within its limits being very largely by auto and wagon road, and trail, and until recent years was reached from the outside world by steamer only. The county is rich in mineral resources, among which are brick, chromite, coal, clay, copper, gold, iron, mineral water, natural gas, petroleum, platinum, silver, and miscellaneous stone.

Nine mineral substances, as shown by the table given below, having a total value of $706,670, were produced in 1926, as compared with the 1925 output of $719,151. The main item is the large amount of rock being used in jetty construction at Humboldt Bay (Eureka Harbor).

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Humboldt ranks twenty-sixth among the counties of the state for the year.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and clay	--	$4,052
Gold	--	1,243
Silver	10 fine oz.	6
Stone, miscellaneous	--	700,736
Other minerals *	--	633
Total value		$706,670

* Includes natural gas and platinum.

IMPERIAL.

Land area: 4089 square miles.
Population: 43,383 (1920 census).
Location: Extreme southeast corner of the state.

During 1926 Imperial County produced ten mineral substances having a total value of $467,314, an increase over the 1925 output of $330,965. Its rank is thirty-third. This county contains deposits of cyanite, gold, gypsum, lead, manganese, marble, pumice, salt, silver, sodium, and strontium, largely undeveloped.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	--	$238
Silver	31 fine oz.	19
Stone, miscellaneous	--	312,130
Other minerals *	--	154,927
Total value		$467,314

* Includes brick, cyanite, gypsum, lead, pumice.

INYO.

Land area: 10,019 square miles.
Population: 7031 (1920 census).
Location: Lies on eastern border of state, north of San Bernardino County.

Inyo, the second largest county in the state, and containing less than one inhabitant per square mile, is extremely interesting from a mineralogical point of view. It is noted because of the fact that within its borders are located both the highest point, Mount Whitney (elevation 14,502 feet), and the lowest point, Death Valley (elevation 290 feet below sea level), in the United States. In the higher mountainous sections are found many vein-forming minerals, and in the lake beds of Death Valley saline deposits exist.

Inyo's mineral production during the year 1926 reached a value of $2,835,834, standing fourteenth among the counties of the state in this respect. Seventeen different mineral substances were produced. The 1925 value was $2,585,145, the increase being due mainly to soda and borates. Its mineral resources include antimony, asbestos, barytes, borates, copper, dolomite, gems, gold, gypsum, lead, marble, soda, sulphur, talc, tungsten, and zinc.

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Commercial production for 1926 was as follows:

Substance	*Amount*		*Value*
Copper	42,462	lbs.	$5,945
Fuller's earth	2,275	tons	20,130
Gold			26,871
Lead	6,541,741	lbs.	523,339
Pumice	300	tons	1,750
Silver	124,508	fine oz.	77,693
Soda	60,473	tons	1,232,081
Stone, miscellaneous			12,000
Talc	6,487	tons	98,563
Zinc	76,889	lbs.	5,767
Other minerals *			831,695
Total value			$2,835,834

* Includes borates, building stone (tuff), dolomite, gems, limestone, salt, tungsten concentrates.

KERN.

Land area: 8003 square miles.
Population: 54,843 (1920 census).
Location: South-central portion of state.

Kern County, because of its immensely productive oil fields, for many years stood preeminent among all counties of California in the value of its mineral output, the exact figures for 1926 being $83,556,074. Kern was surpassed by both Los Angeles and Orange counties in 1923, but by Los Angeles, only, in 1924–1926, for which petroleum is also responsible. The 1925 mineral output for this county was worth $89,400,726. The decrease was due to a smaller quantity of crude oil. During 1926 fourteen different mineral substances were produced.

Among the mineral resources developed and undeveloped, of this section are antimony, asphalt, borax, brick, clay, cement, copper, feldspar, fuller's earth, gems, gold, gypsum, iron, lead, limestone, magnesite, marble, mineral paint, natural gas, petroleum, potash, pumice, salt, silica, silver, soapstone, soda, sulphur, and tungsten.

Commercial production for 1926 was as follows:

Substance	*Amount*		*Value*
Brick	4,591	M	$55,140
Gold			135,508
Natural gas	44,182,140	M cu. ft.	2,158,867
Petroleum	54,549,646	bbls.	78,987,887
Salt	11,279	tons	41,116
Silver	7,479	fine oz.	4,667
Stone, miscellaneous			28,000
Other minerals *			2,144,889
Total value			$83,556,074

* Includes cement, feldspar, fuller's earth (filtering clay), gypsum, lime, pumice, silica.

KINGS.

Land area: 1559 square miles.
Population: 22,031 (1920 census).
Location: South-central portion of the state.

Little development has taken place in Kings County along mineral lines to date. Deposits of fuller's earth, gypsum, mineral paint, natural gas, and quicksilver, of undetermined extent, have been found in the county. Drilling for oil has been under way, and commercial output recorded for the first time in 1926.

Tulare Lake is in Kings County, though now largely drained, and the land under cultivation.

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In fifty-sixth place, commercial mineral production in this county for 1926 was as follows:

Substance	Amount	Value
Natural gas	470 M cu. ft.	$245
Other minerals	---	475
Total value		$720

LAKE.

Land area: 1278 square miles.
Population: 5542 (1920 census).
Location: About fifty miles north of San Francisco Bay and the same distance inland from the Pacific Ocean.

On account of its topography and natural beauties, Lake County is sometimes referred to as the Switzerland of America. The mineral resources which exist here are many and varied, actual production being comparatively small, as shown by the table below, and in the past composed mainly of quicksilver and mineral water. Some of the leading minerals found in this section, in part as yet undeveloped, are asbestos, borax, chromite, clay, copper, gems, gold, gypsum, mineral water, quicksilver, silver, and sulphur.

In forty-eighth place, commercial production for 1926 was as follows:

Substance	Amount	Value
Mineral water	57,000 gals.	$58,235
Quicksilver	86 flasks	7,778
Other minerals*	-----	9,680
Total value		$75,693

*Includes natural gas and miscellaneous stone.

LASSEN.

Land area: 4531 square miles.
Population: 8507 (1920 census).
Location: Northeast portion of state.

Lassen County is one of the only partly-developed sections of California. Since about 1912 a railroad traversing the county north and south has been in operation, thus affording opportunity for development along mineral and other lines.

Among the mineral resources of this county are copper, gems, gypsum, gold, silver, and sulphur. In the past, some gold had been produced, but not for some years, until 1921, when the yield again became important. In fifty-third place, commercial production for 1926 was as follows:

Substance	Amount	Value
Gold	-	$67
Silver	1 fine oz.	1
Stone, miscellaneous	-	18,995
Total value		$19,063

LOS ANGELES.

Land area: 4067 square miles.
Population: 936,438 (1920 census).
Location: One of the southwestern coast counties.

Mineral production in Los Angeles County for the year 1926

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amounted in value to $194,358,926, as compared with the 1925 output, worth $193,180,000. This accounts for 43% of the entire state's total for 1926, and ranks Los Angeles County first in the state as a mineral producer, having in 1924 passed Kern County, which had been leading for several years. The advance in 1926 was due to higher petroleum prices, in spite of a decrease in quantity.

Its output of brick and tile was over three million dollars, and that of petroleum amounted to over one hundred and seventy-four million dollars. Among the mineral resources may be noted asphalt, barytes, borax, brick, clay, fuller's earth, gems, gold, gypsum, infusorial earth, limestone, marble, mineral paint, mineral water, natural gas, petroleum, salt, glass-sand, sandstone, serpentine, silver, soapstone, and miscellaneous stone. Some potash has been obtained from kelp.

Commercial production for 1926, consisting of 16 substances, was as follows:

Substance	*Amount*	*Value*
Brick	238,326 M	$2,954,067
Building tile (hollow)	21,471 tons	192,408
Clay (pottery)	86,767 tons	99,076
Gold	--	94
Lead	1,104,507 lbs.	88,361
Mineral water	4,026,465 gals.	200,459
Natural gas	91,054,793 M cu. ft.	8,965,307
Petroleum	105,826,337 bbls.	174,084,324
Silver	68,362 fine oz.	42,658
Stone miscellaneous	--	7,472,884
Zinc	2,564,188 lbs.	192,314
Other minerals *	--	66,974
Total value		$194,358,926

* Includes building stone (tuff), limestone (marl), salt.

MADERA.

Land area: 2112 square miles.
Population: 12,203 (1920 census).
Location: East-central portion of state.

Madera County produced six different mineral substances during the year 1926, having a total value of $425,738, as compared with the 1925 output worth $1,377,458, the decrease being due to granite. This county contains deposits of copper, gold, granite, iron, lead, molybdenum, pumice, silver, and miscellaneous stone.

In thirty-fifth place, commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	--	$1,708
Granite	--	418,683
Silver	35 fine oz.	22
Stone, miscellaneous	--	5,325
Total value		$425,738

MARIN.

Land area: 529 square miles.
Population: 27,342 (1920 census).
Location: Adjoins San Francisco on the north.

Mineral production in Marin County during 1926 amounted to $527,553, being an increase over the 1925 figure of $434,802, due to crushed rock. This county is not especially prolific in minerals, although among its resources along these lines are brick, gems, manganese, mineral water, soapstone, and miscellaneous stone.

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In thirtieth place, commercial production for 1926 was:

Substance	*Value*
Stone, miscellaneous	$413,712
Other minerals *	113,841
Total value	$527,553

* Includes brick and mineral water.

MARIPOSA.

Land area: 1463 square miles.
Population: 2775 (1920 census).
Location: Most southerly of the Mother Lode counties. East-central portion of state.

Mariposa County is one of the distinctly 'mining' counties of the state, although it stands but fortieth on the list of counties in regard to the value of its mineral output for 1926, with a total of $319,724, as compared with the 1925 figure of $634,862, the decrease being due mainly to stone.

Its mineral resources are varied; among the more important items being barytes, copper, gems, gold, lead, marble, silver, slate, soapstone, and miscellaneous stone.

The Yosemite Valley is in Mariposa County.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	----	$182,313
Silver	2,433 fine oz.	1,518
Stone, miscellaneous	----	130,804
Other minerals *	----	5,089
Total value		$319,724

* Includes barytes, copper, pyrites.

MENDOCINO.

Land area: 3453 square miles.
Population: 24,116 (1920 census).
Location: Joins Humboldt County on the south and bounded by the Pacific Ocean on the west.

Mendocino's annual mineral production has usually been small, the 1926 output being valued at $15,800, ranking it fifty-fourth among the counties. That of 1925 was worth $16,533.

Deposits of in part undetermined value of asbestos, chromite, coal, copper, graphite, magnesite, and mineral water have been found, as well as traces of gold, platinum, and silver.

Commercial production for 1926 was as follows:

Substance	*Value*
Stone, miscellaneous	$15,750
Other minerals	50
Total value	$15,800

MERCED.

Land area: 1995 square miles.
Population: 24,579 (1920 census).
Location: About the geographical center of the state.

Merced County as a whole lies in the San Joaquin Valley and it figures as one of the lesser mineral producing counties of the state.

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The 1926 mineral output was valued at $192,665 compared with $80,262 in 1925, the increase being due to miscellaneous stone.

Gold, platinum, and silver were formerly obtained in important amounts by dredging, which ceased in this county in 1918, though a small yield from other sources is still occasionally had. Undeveloped deposits of antimony, magnesite, quicksilver, and limestone have been noted in this county in addition to the foregoing.

In forty-fifth place, commercial production during 1926 was as follows:

Substance	*Value*
Clay and clay products	$36,179
Stone, miscellaneous	156,486
Total value	$192,665

MODOC.

Land area: 3823 square miles.
Population: 5425 (1920 census).
Location: The extreme northeast corner of the state.

Modoc County, like Lassen, has only in recent years had the benefit of communication with the outside world by rail. Among its known mineral resources are clay, coal, gold, iron, quicksilver, salt, and silver.

In fifty-first place, commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	-	$158
Silver	5 fine oz.	3
Stone, miscellaneous	-	36,450
Other minerals	-	1,380
Total value		$37,991

MONO.

Land area: 3030 square miles.
Population: 960 (1920 census).
Location: Is bordered by the state of Nevada on the east and is about in the central portion of the state measured on a north and south line.

Gold mining has been carried on in portions of Mono County for many years, although taken as a whole it lies in a somewhat inaccessible country so far as rail transportation is concerned. It is in the continuation of the highly mineralized belt which was noted in Inyo County and contains among other mineral resources barytes, clay, copper, gold, limestone, molybdenum, pumice, salt, silver, and travertine.

In forty-fourth place, commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Copper	2,628 lbs.	$368
Gold	------	20,204
Lead	20,906 lbs.	1,672
Silver	194,557 fine oz.	121,404
Stone, miscellaneous	------	1,600
Other minerals*	------	64,600
Total value		$209,848

* Includes onyx, pumice, salt, sillimanite-andalusite.

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MONTEREY.

Land area: 3330 square miles.
Population: 27,980 (1920 census).
Location: West-central portion of state, bordering on Pacific Ocean.

Monterey County produced twelve mineral substances during the year 1926, having a total value of $359,993, as compared with the 1925 output, worth $277,721, the increase being due to miscellaneous stone. Its mineral resources include brick, clay, copper, coal, diatomaceous earth, dolomite, feldspar, fuller's earth, gold, gypsum, limestone, mineral water, petroleum, quicksilver, glass-sand, sandstone, silver, and miscellaneous stone.

In thirty-eighth place, commercial production for 1926 was as follows:

Substance	Amount		Value
Clay (pottery)	491	tons	$1,164
Gold	---		706
Silver	5	fine oz.	3
Stone, miscellaneous	---		263,244
Other minerals *	---		94,876
Total value			$359,993

* Includes diatomaceous earth, dolomite, salt, 'sandstone' (shale building stone), silica (glass-sand).

NAPA.

Land area: 783 square miles.
Population: 20,678 (1920 census).
Location: Directly north of San Francisco Bay—one of the 'bay counties.'

Napa, because of its production of structural and industrial materials and mineral water, stands thirty-ninth on the list of mineral-producing counties in California. Its mineral resources include chromite, copper, magnesite, mineral water, quicksilver, sandstone, and miscellaneous stone. In the past this county has been one of the important producers of quicksilver.

In 1926 the value of the output increased to $341,571 from the 1925 figure of $229,172.

Commercial production for 1926 was as follows:

Substance	Amount		Value
Gold	---		$7,817
Mineral water	80,376	gals.	49,468
Silver	81,116	fine oz.	50,616
Stone, miscellaneous	-----		207,882
Other minerals *	-----		25,788
Total value			$341,571

* Includes copper and quicksilver.

NEVADA.

Land area: 974 square miles.
Population: 10,860 (1920 census).
Location: North of Lake Tahoe, on the eastern border of the state.

Nevada, one of the mountain counties of California, for some years alternated with Amador in the gold lead, but both were passed by Yuba in 1918–1921, also 1923. In 1922 and 1924, Nevada led, but dropped to third place in 1925, regaining second in 1926. Nevada County stands tenth on the list in regard to value of its total mineral output with a

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figure of $3,240,211, as compared with the 1925 production, worth $2,352,877. The increase is due mainly to miscellaneous stone, but in part to gold.

While this county actually produces mainly gold and silver, its resources cover a wide scope, including antimony, asbestos, barytes, chromite, clay, copper, gems, iron, lead, mineral paint, pyrites, soapstone, and tungsten.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$2,318,846
Lead	4,301 lbs.	344
Silver	48,101 fine oz.	30,015
Stone, miscellaneous	-----	850,000
Other minerals *	-----	41,006
Total value		$3,240,211

* Includes barytes, copper, granite.

ORANGE.

Land area: 795 square miles.
Population: 61,375 (1920 census).
Location: Southwestern portion of state, bordering Pacific Ocean.

Orange County is one of the many in California which on casual inspection appears to be anything but a mineral producing section. It stood for several years, however, as the second county in the state in regard to the total value of mineral output, on account of its highly productive oil fields. It was passed in 1922 by Los Angeles, the credit for which is also due to oil, and in turn Orange passed Kern County in 1923, but dropped back to third in 1924–1926.

This county shows an increase in 1926, with a total value of mineral products of $63,223,082, compared to the 1925 output, worth $49,104,490, due to petroleum. Orange passed Shasta County in 1917, which previously for a number of years had exceeded all other counties in California, except Kern.

Aside from the substances actually produced and noted in the table below, coal, gypsum, iron, infusorial earth, sandstone, and tourmaline have been found in Orange County.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick	6,272 M	$72,489
Clay (pottery)	13,150 tons	38,989
Gold	---------	60
Lead	5,176 lb.	414
Natural gas	33,276,379 M cu. ft.	3,556,194
Petroleum	37,989,349 bbls.	59,225,395
Silver	1,550 fine oz.	967
Stone, miscellaneous	---------	317,767
Other minerals *	---------	10,807
Total value		$63,223,082

* Includes copper, potash, zinc.

PLACER.

Land area: 1395 square miles.
Population: 18,584 (1920 census).
Location: Eastern border of state directly west of Lake Tahoe.

While standing only thirty-second on the list of mineral producing counties, Placer contains a wide variety of mineral substances, some of

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which have not been commercially exploited. Its leading products include gold, chromite, granite, copper, and clay. Other mineral resources are asbestos, brick, coal, gems, iron, lead, limestone, magnesite, manganese, marble, quartz crystals, glass-sand, silver, and miscellaneous stone.

Commercial production for 1926 was as follows, compared to a total value of $550,413 for the preceding year:

Substance	*Amount*		*Value*
Brick and hollow building tile	------		$150,591
Clay (pottery)	104,250	tons	147,241
Gold	------		82,921
Granite	6,092	cu. ft.	11,969
Silver	554	fine oz.	346
Stone, miscellaneous	------		81,814
Other minerals	------		6,000
Total value			$480,882

PLUMAS.

Land area: 2594 square miles.
Population: 5681 (1920 census).
Location: Northeastern border of state, south of Lassen County.

A considerable portion of the area of Plumas County lies in the high mountains, and deposits of the metals, especially gold and copper, are found there. Mineral production for 1926 was valued at $3,572,628, the decrease being due to copper and silver. This placed the county eighth in rank. In 1919 Plumas passed Shasta in the copper lead, owing to the Shasta smelters being closed down, which position Plumas still retains.

Among its mineral resources are chromite, copper, gold, granite, iron, lead, limestone, manganese, molybdemum, platinum, silver, and zinc.

Commercial production for 1926 was as follows:

Substance	*Amount*		*Value*
Copper	22,163,035	lbs.	$3,102,825
Gold	----------		247,667
Silver	347,147	fine oz.	216,620
Other minerals *	----------		5,516
Total value			$3,572,628

* Includes granite, lead, manganese ore, platinum.

RIVERSIDE.

Land area: 7240 square miles.
Population: 60,297 (1920 census).
Location: Southern portion of state.

Riverside is the fourth county in the state in size and the seventh in regard to the total value of mineral output for 1926. Within its borders are included mountain, desert, and agricultural land. Its mineral resources include metals, structural and industrial materials, and salines, some of the more important being brick, clay, coal, copper, feldspar, gems, gold, gypsum, iron, lead, limestone, manganese, magnesite, marble, mineral paint, mineral water, salt, soapstone, silver, miscellaneous stone, and tin. In point of variety, Riverside County showed eighteen different minerals commercially produced in 1926. The increase in 1926

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from the 1925 value of $5,179,108 was due to cement, brick, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	------	$610,100
Clay (pottery)	58,528 tons	178,383
Copper	22,125 lbs.	3,096
Gold	------	2,931
Gypsum	26,140 tons	71,907
Lead	173,207 lbs.	13,857
Silica (quartz)	20,587 tons	72,510
Silver	5,024 fine oz.	3,135
Stone, miscellaneous	------	1,180,278
Other minerals *	------	4,058,056
Total value		$6,194,253

* Includes cement, feldspar, granite, mineral water, onyx, slate.

SACRAMENTO.

Land area: 983 square miles.
Population: 90,978 (1920 census).
Location: North-central portion of state.

Sacramento stands nineteenth among the counties of the state as a mineral producer, the output, principally gold, for 1926 being valued at $2,243,952, as compared with the 1925 production, worth $2,504,405.

In regard to gold output alone, this county ranks fourth, being exceeded only by Yuba, Nevada and Amador counties, the Sacramento product coming from the dredges. Its mineral resources include brick, clay, gold, granite, natural gas, platinum, silver, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	----	$388,697
Clay (pottery)	1,528 tons	2,310
Gold	----	1,304,046
Granite	6,250 cu. ft.	7,812
Silver	2,607 fine oz.	1,627
Stone, miscellaneous	----	438,086
Other minerals *	----	101,374
Total value		$2,243,952

* Includes natural gas and platinum.

SAN BENITO.

Land area: 1392 square miles.
Population: 8995 (1920 census).
Location: West-central portion of state.

While eighteenth among the counties of the state in regard to value of total mineral production for 1926, San Benito has led for some years in one important branch of the mineral industry, namely, quicksilver. Cement is also an important item.

Its other mineral resources, many of them undeveloped, include antimony, asbestos, bituminous rock, chromite, coal, dolomite, gems, gypsum, limestone, magnesite, mineral water, and miscellaneous stone.

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Commercial production for 1926 was as follows:

Substance	*Value*
Stone, miscellaneous	$328,460
Other minerals*	2,072,390
Total value	$2,400,850

* Includes antimony, asbestos, cement, dolomite, magnesite, mineral water, quicksilver.

SAN BERNARDINO.

Land area: 20,157 square miles.
Population: 73,401 (1920 census).
Location: Southeastern portion of state.

San Bernardino, by far the largest county in the state in area, ranks fifth as regards the value of its mineral output for 1926 with a total of $14,218,475, as compared with the 1925 total of $14,179,663. The increase is due mainly to cement, in spite of decreases in gold and silver.

San Bernardino for several years (except 1918) has led all other counties in the state in point of variety of minerals, producing commercially during 1926 a total of 24 different substances. This county also ranks first as a silver producer in the state, from the mines of the Randsburg district.

This county, consisting largely of mountain and desert country, is highly mineralized, the following being included among its resources: Asbestos, barytes, borax, brick, cement, clay, copper, gems, gold, granite, gypsum, iron, lead, limestone, manganese, marble, mineral paint, mineral water, nitre, potash, salt, soapstone, soda, miscellaneous stone, strontium, talc, tungsten, vanadium, and zinc.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Cement	5,135,840 bbls.	$9,273,627
Clay (pottery)	2,268 tons	10,605
Copper	171,232 lbs.	23,972
Gold	-------	106,875
Lead	195,536 lbs.	15,643
Lime	13,680 tons	96,310
Limestone	11,226 tons	49,504
Salt	22,522 tons	85,463
Silver	884,045 fine oz.	551,644
Soda (trona)	2,860 tons	73,721
Stone, miscellaneous	-------	404,681
Talc	8,134 tons	142,280
Other minerals*	-------	3,384,150
Total value		$14,218,475

* Includes borates, calcium chloride, fuller's earth (filtering clay), magnesite, mineral water, petroleum, potash, silica, tungsten consentrates, zinc.

SAN DIEGO.

Land area: 4221 square miles.
Population: 112,248 (1920 census).
Location: Extreme southwest corner of state.

San Diego ranks twenty-third in the total value of its mineral output for the year, with 21 different commercial minerals. The value for 1926 equaled $1,241,324, as compared with the 1925 output, worth $1,129,757.

In the production of gems, San Diego County has led the state. Aside from minerals commercially produced, as shown below, San Diego County contains occurrences of bismuth, lithia, marble, nickel, soapstone, and tin. Potash has been produced from kelp.

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Commercial production for 1926 was as follows:

Substance	Amount	Value
Brick and hollow building tile	------	$230,484
Clay (pottery)	30,187 tons	58,269
Feldspar	7,000 tons	54,000
Gems	------	4,000
Gold	------	10,543
Granite	16,273 cu. ft.	45,327
Mineral water	156,380 gals.	23,259
Silver	545 fine oz.	340
Stone, miscellaneous	------	529,640
Other minerals *	------	285,462
Total value		$1,241,324

* Includes bromine, copper, fuller's earth (filtering clay), lead, lithia, magnesium chloride, salt, zinc.

SAN FRANCISCO.

Land area: 46½ square miles.
Population: 506,676 (1920 census).

Surprising as it may appear at first glance, San Francisco County is listed among the mineral producing sections of the state, actual production consisting mainly of crushed rock, sand and gravel. Small quantities of various valuable mineral substances are found here, including cinnabar, gypsum, lignite, and magnesite, none, however, in paying quantities. Some pumice has been produced.

In forty-sixth place, commercial production for 1926 was as follows:

Substance	Value
Stone, miscellaneous	$112,193

SAN JOAQUIN.

Land area: 1448 square miles.
Population: 79,905 (1920 census).
Location: Central portion of state.

San Joaquin County reported a mineral production for the year 1926 having a total value of $842,000, as compared with the 1925 output, worth $737,818.

Comparatively few mineral substances are found here, the chief ones being brick, clay, manganese, natural gas, glass-sand, and miscellaneous stone. Gold, platinum, and silver have been obtained by dredging in the Mokelumne River, which forms the boundary between this county and Amador on the northeast.

In twenty-fifth place, commercial production for 1926 was as follows:

Substance	Value
Brick and hollow building tile	$511,448
Stone, miscellaneous	129,037
Other minerals	201,515
Total value	$842,000

SAN LUIS OBISPO.

Land area: 3334 square miles.
Population: 21,893 (1920 census).
Location: Bordered by Kern County on the east and the Pacific Ocean on the west.

The total value of the mineral production of San Luis Obispo County in 1926 was $253,294, as compared with the 1925 output, worth $136,477, the increase being due to miscellaneous stone.

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Among its mineral resources, both developed and undeveloped, are asphalt, bituminous rock, brick, chromite, coal, copper, diatomaceous earth, gypsum, iron, limestone, marble, mineral water, onyx, petroleum, quicksilver, soda, and miscellaneous stone.

In forty-second place, commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Clay and clay products	-----	$22,914
Petroleum	27,982 bbls.	22,162
Stone, miscellaneous	-----	193,138
Other minerals *	-----	15,080
Total value		$253,294

* Includes chromite, mineral water, natural gas, quicksilver.

SAN MATEO.

Land area: 447 square miles.
Population: 36,781 (1920 census).
Location: Peninsula, adjoined by San Francisco on the north.

San Mateo's most important mineral products are cement, stone and salt, the last-named being derived by evaporation from the waters of San Francisco Bay. The total value of all mineral production during 1926 equaled $1,893,853, as compared with the 1925 figures of $1,577,513, the increase being due to cement.

Small amounts of barytes, chromite, infusorial earth, and quicksilver have been noted in addition to the items of economic value given below. Bricks have also been produced commercially.

In twentieth place, commercial production for 1926 was as follows:

Substance	*Value*
Stone, miscellaneous	$77,470
Other minerals *	1,816,383
Total value	$1,893,853

*Includes cement, magnesium chloride, natural gas, petroleum, salt.

SANTA BARBARA.

Land area: 2740 square miles.
Population: 41,097 (1920 census).
Location: Southwestern portion of state, adjoining San Luis Obispo on the south.

Santa Barbara County owes its position of fifteenth in the state in regard to its mineral output to the presence of productive oil fields within its boundaries. The total value of its mineral production during the year 1926 was $2,583,548, as compared with the 1925 output of $4,338,431, and included twelve different mineral substances. The decrease was due to petroleum and diatomaceous earth.

Aside from the mineral substances listed below, Santa Barbara County contains asphalt, gilsonite, gypsum, magnesite, and quicksilver in more or less abundance.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Brick and hollow building tile	-----	$17,076
Clay (pottery)	1,100 tons	1,700
Natural gas	2,230,501 M cu. ft.	246,091
Petroleum	1,925,204 bbls.	1,526,587
Stone, miscellaneous	-----	88,575
Other minerals *	-----	703,519
Total value		$2,583,548

* Includes bituminous rock, diatomaceous earth, mineral water, shale oil.

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SANTA CLARA.

Land area: 1328 square miles.
Population: 100,588 (1920 census).
Location: West-central portion of state.

Santa Clara County reported a mineral output for 1926 of $1,028,506 as compared with the 1925 figures of $1,320,858.

This county, lying largely in the Coast Range Mountains, contains a wide variety of mineral substances, including brick, chromite, clay, limestone, magnesite, manganese, mineral water, petroleum, quicksilver, soapstone, and miscellaneous stone.

In twenty-fourth place, commercial production for 1926 was as follows:

Substance	*Value*
Clay and clay products	$197,998
Stone, miscellaneous	478,231
Other minerals *	352,277
Total value	$1,028,506

* Includes magnesite, mineral water, natural gas, petroleum.

SANTA CRUZ.

Land area: 435 square miles.
Population: 26,269 (1920 census).
Location: Bordering Pacific Ocean, just south of San Mateo County.

The mineral output of Santa Cruz County, a portion of which is itemized below, amounted to a total value of $3,504,194, giving the county a standing of ninth among all others in the state in this regard. The increase over the 1925 figure of $3,227,036 is due to cement.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	-----	$143
Lime	15,457 tons	227,904
Silver	1 fine oz.	1
Stone, miscellaneous	-----	26,361
Other minerals *	-----	3,249,785
Total value		$3,504,194

* Includes bituminous rock, cement, limestone.

SHASTA.

Land area: 3858 square miles.
Population: 13,311 (1920 census).
Location: North-central portion of state.

Shasta County stood thirteenth in California among the mineral producing counties for 1926, with an output valued at $2,886,144, as compared with the 1925 production, worth $4,300,449, the decrease being due to copper, and in part to gold and stone, though zinc advanced.

The marked decrease since 1918 is due to the falling off in the output of copper, the large plants of the Mammoth and Mountain copper companies being shut down. Not taking petroleum into account, Shasta for a number of years led all of the counties by a wide margin, but in 1919–1923 was passed by San Bernardino, Plumas, Yuba, Inyo, Sacra-

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mento, Nevada, and Amador, among the 'metal' counties, though by only San Bernardino and Plumas of that group in 1925.

Shasta's mineral resources include asbestos, barytes, brick, chromite, coal, copper, gold, iron, lead, lime, limestone, mineral water, molybdenum, pyrites, silver, soapstone, miscellaneous stone, and zinc.

Lassen Peak is located in southeastern Shasta County.

Commercial production for 1926 was as follows:

Substance	Amount		Value
Copper	5,113,114	lbs.	$715,836
Gold	----------		132,906
Lead	15,584	lbs.	1,247
Platinum	28	fine oz.	3,034
Silver	177,434	fine oz.	110,719
Stone, miscellaneous	----------		162,355
Zinc	17,757,000	lbs.	1,331,775
Other minerals*	----------		428,272
Total value			$2,886,144

* Includes coal, diatomaceous earth, iron ore, lime, limestone, pyrites, talc.

SIERRA.

Land area: 923 square miles.
Population: 1783 (1920 census).
Location: Eastern border of state, just north of Nevada County.

Sierra County reported a mineral production of $569,515 mainly of gold and silver, during the year 1926, as compared with the 1925 output, worth $1,386,301, the decrease being due to gold. Considering gold output alone this county stands sixth; and as to total mineral yield twenty-ninth.

Aside from the metals itemized below, Sierra County contains deposits of asbestos, chromite, copper, iron, lead, platinum, serpentine, and talc.

Commercial production for 1926 was as follows:

Substance	Amount		Value
Gold	----		$564,452
Silver	4,669	fine oz.	2,913
Stone, miscellaneous	----		2,150
Total value			$569,515

SISKIYOU.

Land area: 6256 square miles.
Population: 18,545 (1920 census).
Location: Extreme north-central portion of state, next to Oregon boundary.

Siskiyou, fifth county in California in regard to size, located in a highly mineralized and mountainous country, ranks thirty-first in regard to the value of its mineral output for 1926.

Although this county is traversed by a transcontinental railroad in a north and south line, the mineral-bearing sections are almost without exception far from transportation and other facilities. A large part of the country is accessible by trail only. Future development and exploitation will increase the productiveness of this part of the state to a considerable degree.

Mount Shasta is located in Siskiyou County.

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Among Siskiyou's mineral resources are chromite, clay, coal, copper, gems, gold, lead, limestone, manganese, marble, mineral water, pumice, quicksilver, sandstone, silver, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Gold	----	$141,240
Platinum	16 fine oz.	1,780
Silver	1,137 fine oz.	709
Stone, miscellaneous	----	327,569
Other minerals *	----	22,853
Total value		$494,151

* Includes coal, lead, mineral water, sandstone.

SOLANO.

Land area: 822 square miles.
Population: 40,602 (1920 census).
Location: Touching San Francisco Bay on the northeast.

Solano, while mostly valley land, produced mineral substances during the year 1926 to the total value of $1,770,820, ranking twenty-second among the counties of the state, the decrease from the 1925 figures of $2,678,547 being due to cement and miscellaneous stone.

Among her mineral resources are brick, cement, clay, fuller's earth, limestone, mineral water, natural gas, onyx, quicksilver, salt, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Value*
Unapportioned *	$1,770,820

* Includes cement, mineral water, onyx, travertine.

SONOMA.

Land area: 1577 square miles.
Population: 51,990 (1920 census).
Location: South of Mendocino County, bordering on the Pacific Ocean.

Sonoma ranked forty-third among the counties of California during the year 1926, with a mineral production of $222,586, as compared with its 1925 output of $160,231. More paving blocks have been turned out here than in any other section of the state, but this industry has now ceased, owing to the construction of smooth-surface pavements both in the cities and on the highways.

Among Sonoma's mineral resources are brick, chromite, clay, copper, graphite, infusorial earth, magnesite, manganese, marble, mineral paint, mineral water, quicksilver, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Mineral water	36,272 gals.	$7,752
Stone, miscellaneous	-----	208,479
Other minerals *	-----	6,355
Total value		$222,586

* Includes pottery clay, gems, manganese ore, petroleum, quicksilver.

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STANISLAUS.

Land area: 1450 square miles.
Population: 43,557 (1920 census).
Location: Center of state, bounded on south by Merced County.

Gold has usually been the chief mineral product of Stanislaus County, but it was exceeded in 1918–1919 by manganese, and in 1921–1923 and 1925–1926 by miscellaneous stone. Brick, clay, gypsum, mineral paint, quicksilver, and silver are found here to some extent as well. This county for 1926 ranks thirty-sixth in the state in regard to value of minerals, with an output of $401,997, as compared with $415,466 in 1925, the decrease being due to gold. Gold, platinum, and silver are obtained mainly by dredging.

Commercial production for 1926 was as follows:

Substance	Amount	Value
Gold	---	$127,398
Silver	659 fine oz.	411
Stone, miscellaneous	---	261,231
Other minerals*	---	12,957
Total value		$401,997

*Includes magnesite, mineral paint, platinum.

SUTTER.

Land area: 608 square miles.
Population: 10,115 (1920 census).
Location: Bounded by Butte County on the north and Sacramento on the south.

Sutter is one of only two counties in the state which for a number of years reported no commercial output of some kind of mineral substance. In 1917 some crushed rock was taken out, from the Marysville Buttes, also in 1925–1926. There has been some utilization of natural gas. The 1926 mineral yield was valued at $397, being concealed under 'unapportioned.' Both clay and coal exist here, but deposits of neither mineral have been placed on a productive basis.

TEHAMA.

Land area: 2893 square miles.
Population: 12,882 (1920 census).
Location: North-central portion of the state, bounded on the north by Shasta.

Tehama stands fifty-fifth among the mineral producing counties of the state for 1926, when its output was valued at $10,340, as compared with the 1925 yield, worth $77,183, the decrease being due to stone.

Among its mineral resources are listed brick, chromite, copper, gold, manganese, marble, mineral water, salt, and miscellaneous stone.

The 1926 yield was distributed as follows:

Substance	Value
Stone, miscellaneous	$2,100
Other minerals*	8,240
Total value	$10,340

*Includes brick and chromite.

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TRINITY.

Land area: 3166 square miles.
Population: 2551 (1920 census).
Location: Northwestern portion of state.

Trinity, like its neighbor, Siskiyou County, requires transportation facilities to further the development of its many and varied mineral resources. Deposits of asbestos, barytes, chromite, copper, gold, mineral water, platinum, quicksilver, silver, and building stone are known here, but with the exception of gold, chromite, copper, quicksilver and platinum, very little active production of these mineral substances has been made as yet. The 1926 output of $611,797 shows an increase over the 1925 figure of $502,289, due to copper and gold, giving the county rank of twenty-eighth for the year.

Substance	*Amount*	*Value*
Copper	760,140 lbs.	$106,420
Gold	------	483,471
Platinum	28 fine oz.	2,832
Silver	21,275 fine oz.	13,276
Stone, miscellaneous	------	1,798
Other minerals	------	4,000
Total value		$611,797

TULARE.

Land area: 4856 square miles.
Population: 59,031 (1920 census).
Location: Bounded by Inyo on the east, Kern on the south, Fresno on the north.

Tulare stands thirty-seventh on the list of mineral producing counties, the decrease from the 1925 value being due mainly to magnesite.

This county's mineral resources, among others, are brick, clay, copper, feldspar, graphite, gems, limestone, magnesite, marble, quartz, glass-sand, soapstone, miscellaneous stone, and zinc. Tulare for a number of years led the state in magnesite output, except in 1918 when it was passed by Napa County, and since 1921 by Santa Clara.

Commercial production for 1926 was as follows:

Substance	*Amount*	*Value*
Lime	593 tons	$7,709
Limestone	18,000 tons	70,000
Magnesite	13,378 tons	138,347
Stone, miscellaneous	-----	73,881
Other minerals *	-----	107,983
Total value		$397,920

* Includes brick, building tile, granite, natural gas.

TUOLUMNE.

Land area: 2190 square miles.
Population: 7768 (1920 census).
Location: East-central portion of state—Mother Lode District.

Tuolumne ranks twenty-seventh among counties of the state relative to its total value of mineral output for 1926. This county ranks first as a producer of marble in the state. The increase in the year's valuation to $615,998 for 1926 from the 1925 figure of $567,248 was due mainly to gold.

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Chromite, clay, copper, gold, lead, limestone, marble, mineral paint, platinum, soapstone, silver, and miscellaneous stone are among its mineral resources.

Commercial production for 1926 was as follows:

Substance	Amount	Value
Gold	----	$119,873
Silver	1,793 fine oz.	1,119
Stone, miscellaneous	----	56,097
Other minerals *	----	438,909
Total value		$615,998

* Includes copper, granite, lead, lime, limestone, magnesite, marble, silica.

VENTURA.

Land area: 1878 square miles.
Population: 28,724 (1920 census).
Location: Southwestern portion of state, bordering on Pacific Ocean.

Ventura is the fourth county in the state in respect to the value of its mineral production for 1926, the exact figure being $30,208,369, as compared with the output for 1925, worth $17,853,540, the increase being due to petroleum and natural gas.

The highest gravity petroleum produced in the state is found here. Among its other mineral resources are asphalt, borax, brick, clay, mineral water, natural gas, sandstone, and miscellaneous stone.

Commercial production for 1926 was as follows:

Substance	Amount	Value
Clay	373,000 tons	$93,250
Natural gas	41,559,144 M cu. ft.	4,080,040
Petroleum	16,994,275 bbls.	25,695,344
Stone, miscellaneous	----	339,435
Other minerals	----	300
Total value		$30,208,369

YOLO.

Land area: 1017 square miles.
Population: 17,105 (1920 census).
Location: Sacramento Valley, bounded by Sutter on the east and Colusa on the north.

The mineral production from Yolo County during the year 1926 consisted entirely of miscellaneous stone, valued at $20,560, ranking it in fifty-second place. Deposits of undetermined value of iron and sandstone have been discovered within the confines of this county. Quicksilver has also been produced.

YUBA.

Land area: 639 square miles.
Population: 10,375 (1920 census).
Location: Lies west of Sierra and Nevada counties; south of Plumas.

Yuba is twelfth of the mineral producing counties of the state, and first in regard to gold output for 1925–1926, having passed Nevada and Amador counties in that metal. Iron and clay deposits have been

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reported in this county aside from the following commercial production shown for the year 1926. The increase over the 1925 figure of $2,721,594 was due mainly to gold obtained by the dredgers, which also yield silver and platinum. The 1921 dredge yield of gold was a record for the county.

The 1926 production of Yuba County was distributed as follows:

Substance	*Amount*	*Value*
Gold	-----	$2,769,703
Silver	10,235 fine oz.	6,398
Stone, miscellaneous	-----	133,298
Other minerals *	-----	11,695
Total value		$2,921,083

* Includes natural gas and platinum.

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APPENDIX.

MINING BUREAU ACT.

Chapter 679.

[Stats. 1913.]

An act establishing a state mining bureau, creating the office of state mineralogist, fixing his salary and prescribing his powers and duties; providing for the employment of officers and employees of said bureau, making it the duty of persons in charge of mines, mining operations and quarries to make certain reports, providing for the investigation of mining operations, dealings and transactions and the prosecution for defrauding, swindling and cheating therein, creating a state mining bureau fund for the purpose of carrying out the provisions of this act and repealing an act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all acts amendatory thereof and supplemental thereto or in conflict herewith.

[Approved June 16, 1913. In effect August 10, 1913.]

The people of the State of California do enact as follows:

SECTION 1. There is hereby created and established a state mining bureau. The chief officer of such bureau shall be the state mineralogist, which office is hereby created.

SEC. 2. It shall be the duty of the governor of the State of California and he is hereby empowered to appoint a citizen and resident of this state, having a practical and scientific knowledge of mining, to the office of state mineralogist. Said state mineralogist shall hold his office at the pleasure of the governor. He shall be a civil executive officer. He shall take and subscribe the same oath of office as other state officers. He shall receive for his services a salary of three hundred dollars ($300) per month, to be paid at the same time and in the same manner as the salaries of other state officers. He shall also receive his necessary traveling expenses when traveling on the business of his office. He shall give bond for the faithful performance of his duties in the sum of ten thousand dollars ($10,000), said bond to be approved by the governor of the State of California.

SEC. 3. Said state mineralogist shall employ competent geologists, field assistants, qualified specialists and office employees when necessary in the execution of his plans and operations of the bureau, and fix their compensation. The said employees shall be allowed their necessary traveling expenses when traveling on the business of said department and shall hold office at the pleasure of said state mineralogist.

SEC. 4. It shall be the duty of said state mineralogist to make, facilitate, and encourage special studies of the mineral resources and mineral industries of the state. It shall be his duty: to collect statistics concerning the occurrence and production of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make a collection of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collection constituting the museum of the state mining bureau; to provide a library of books, reports, drawings, bearing upon the mineral industries, and sciences of mineralogy and geology, and arts of mining and metallurgy, such library constituting the library of the state mining bureau; to make a collection of models, drawings and descriptions of the mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of this state, to consist of such collections and library, and to arrange, classify, catalogue, and index the data therein contained, in a manner to make the information available to those desiring it; to issue from time to time such bulletins as he may deem advisable concerning the statistics and technology of the mineral industries of this state.

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SEC. 5. It is hereby made the duty of the owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character, within the state, to forward to the state mineralogist, upon his request, at his office not later than the thirtieth day of June, in each year, a detailed report upon forms which will be furnished showing the character of the mine, the number of men then employed, the method of working such mine and the general condition thereof, the total mineral production for the past year, and such owner, lessor, lessee, agent, manager or other person in charge of any mine within the state must furnish whatever information relative to such mine as the state mineralogist may from time to time require for the proper discharge of his official duties. Any owner, lessor, lessee, agent, manager or other person in charge of each and every mine, of whatever kind or character within the state, who fails to comply with the above provisions shall be deemed guilty of a misdemeanor.*

SEC. 6. The state mineralogist now performing the duties of the office of state mineralogist shall perform the duties of the office of state mineralogist as in this act provided until the appointment and qualification of his successor as in this act provided.

SEC. 7. The said state mineralogist shall take possession, charge and control of the offices now occupied and used by the board of trustees and state mineralogist and the museum, library and laboratory of the mining bureau located in San Francisco as provided for by a certain act of the legislature approved March 23, 1893, and hereafter referred to in section fourteen hereof, and shall maintain such offices, museum, library and laboratory for the purposes provided in this act.

SEC. 8. Said state mineralogist or qualified assistant shall have full power and authority at any time to enter or examine any and all mines, quarries, wells, mills, reduction works, refining works and other mineral properties or working plants in this state in order to gather data to comply with the provisions of this act.

SEC. 9. The state mineralogist shall make a biennial report to the governor on or before the fifteenth day of September next preceding the regular session of the legislature.

SEC. 10. All moneys received by the state mining bureau or any officer thereof (except such as may be paid to them by the state for disbursement) shall be receipted for by the state mineralogist or other officer authorized by him to act in his place and at least once a month accounted for by him to the state controller and paid into the state treasury to the credit of a fund which is hereby created and designated "state mining bureau fund." All moneys now in the possession of the state mining bureau or any officer thereof received from any source whatsoever, shall be immediately paid over to the state mineralogist and by him accounted for to the controller and paid into the state treasury to the credit of said fund. Said fund shall be used and is hereby appropriated for the use of said bureau in carrying out the purposes of this act.

SEC. 11. The said state mineralogist is hereby authorized and empowered to receive on behalf of this state, for the use and benefit of the state mining bureau, gifts, bequests, devises and legacies of real or other property and to use the same in accordance with the wishes of the donors, and if no instructions are given by said donors, to manage, use, and dispose of the gifts and bequests and legacies for the best interests of said state mining bureau and in such manner as he may deem proper.

SEC. 12. The state mineralogist may, whenever he deems it advisable, prepare a special collection of ores and minerals of California to be sent to or used at any world's fair or exposition in order to display the mineral wealth of the state.

SEC. 13. The state mineralogist is hereby empowered to fix a price upon and to dispose of to the public, at such price, any and all publications of the state mining bureau, including reports, bulletins, maps, registers or other publications, such price shall approximate the cost of publication and distribution. Any and all sums derived from such disposition, or from gifts or bequests made, as hereinbefore provided must be accounted for by said state mineralogist and turned over to the state treasurer to be credited to the mining bureau fund as provided for in section ten. He is also empowered to furnish without cost to public libraries the publications of the bureau and to exchange publications with other geological surveys and scientific societies, etc.

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*Sec. 19 of the Penal Code of California provides: "Except in cases where a different punishment is prescribed by this code, every offense declared to be a misdemeanor is punishable by imprisonment in a county jail not exceeding six months, or by a fine not exceeding five hundred dollars, or by both."

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SEC. 14. The state mineralogist provided for by this act shall be the successor in interest of the board of trustees of the state mining bureau, and the state mineralogist, under and by virtue of that certain act, entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, who shall have the direction, management, and control of said state mining bureau, and to provide for the appointment, duties, and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, and all books, papers, documents, personal property, records, and property of every kind and description obtained or possessed, or held or controlled by the said board of trustees of the said state mining bureau, and the state mineralogist, and the clerks and employees thereof, under the provisions of said act of March 23, 1893, or any act supplemental thereto or amendatory thereof, shall immediately be turned over and delivered to the said state mineralogist herein provided for, who shall have charge and control thereof.

SEC. 15. That certain act entitled "An act to provide for the establishment, maintenance, and support of a bureau, to be known as the state mining bureau, and for the appointment and duties of a board of trustees, to be known as the board of trustees of the state mining bureau, and to provide for the appointment, duties and compensation of a state mineralogist, who shall perform the duties of his office under the control, direction, and supervision of the board of trustees of the state mining bureau," approved March 23, 1893, together with all acts amendatory thereof and supplemental thereto and all acts in conflict herewith are hereby repealed.

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DEPARTMENT OF NATURAL RESOURCES ACT.

Chapter 128.

[Stats. 1927.]

An act to add a new article to chapter three of title one of part three of the Political Code, to be numbered article two j, embracing sections three hundred seventy-three to three hundred seventy-three i, relating to a department of natural resources.

[Approved by the Governor April 13, 1927.]

The people of the State of California do enact as follows:

SECTION 1. The Political Code is hereby amended by adding a new article to chapter III of title I of part III thereof, to be numbered article II*j*, embracing sections 373 to 373*i* and to read as follows:

ARTICLE II*j*.

DEPARTMENT OF NATURAL RESOURCES.

373. A department of the government of the State of California to be known as the department of natural resources is hereby created. The department shall be conducted under the control of an executive officer to be known as the director of natural resources, which office is hereby created. The director shall be appointed by and hold office at the pleasure of the governor and shall receive a salary of six thousand dollars per annum.

Except as in this article otherwise provided, the provisions of article II of this chapter, title, and part of the Political Code as adopted at the forty-fourth session of the Legislature and as the same may be amended from time to time shall govern and apply to the conduct of the department of natural resources in every respect the same as if such provisions were herein set forth at length and wherever in said article II the term "head of the department" or similar designation occurs, the same shall for the purposes of this article mean the director of natural resources.

373*a*. For purposes of administration the department shall be forthwith organized by the director thereof, subject to the approval of the governor, in such manner as he shall deem necessary to properly segregate and conduct the work of the department, and the director shall have power to appoint in accordance with the civil service and other provisions of law such deputies, officers and other expert and clerical assistants as may be necessary. The work of the department is hereby divided into at least four divisions to be known as the division of mines and mining, the division of forestry, the division of parks and the division of fish and game.

373*b*. The division of mines and mining shall be administered through a chief of division who shall also be known as the state mineralogist. He shall be appointed by the director of natural resources and shall receive a salary of six thousand dollars per annum.

373*c*. The division of forestry shall be administered through a chief of division who shall be known as the state forester, who shall be a technically trained forester, appointed by the director of natural resources upon nomination by the state board of forestry hereinafter provided. General policies for the guidance of the division of forestry shall be determined by a state board of forestry which shall consist of seven members appointed by and holding office at the pleasure of the governor. Of the seven members one shall be familiar with the pine timber industry, one with the redwood industry, one with the live stock industry, one with general agriculture and one with the problems of water conservation.

373*d*. The division of parks shall be administered through a chief of division who shall be appointed by the director of natural resources upon nomination by the state park commission hereinafter provided. General polices for the administration of the state park system shall be determined by the state park commission which is hereby created to consist of five members appointed by the governor and holding office at his pleasure.

373*e*. The division of fish and game shall be administered through a fish and game commission consisting of three members appointed by and holding office at the pleasure of the governor.

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373*f*. The chiefs of the divisions of forestry and parks respectively shall receive such salaries as may be determined by the director with the approval of the governor. The director of natural resources and the chief of each division before entering upon his duties shall execute to the State of California an official bond in the penal sum of twenty-five thousand dollars conditioned upon the faithful performance of his duties. The members of the board of forestry, the state parks commission and fish and game commission shall serve without compensation, but shall be entitled to their actual expenses incurred in the performance of their duties.

373*g*. The department of natural resources shall succeed to and is hereby invested with all the duties, powers, purposes, responsibilities and jurisdiction of the state mining bureau, state mineralogist, department of petroleum and gas, state oil and gas supervisor, state forester, state board of forestry, California redwood park commission, San Pasqual battlefield commission, Mount Diablo park commission, state fish and game commission, state fish and game commissioners, and, except as herein otherwise provided, of the several officers, deputies and employees of such bodies and offices, and whenever by the provisions of any statute or law now in force or that may hereafter be enacted a duty or jurisdiction is imposed or authority conferred upon any of said officers, offices, bodies, deputies or employees by any statute the enforcement of which is transferred to the department, such duty, jurisdiction and authority are hereby imposed upon and transferred to the department of natural resources and the appropriate officers thereof with the same force and effect as though the title of said department of natural resources had been specifically set forth and named therein in lieu of the name of any such body, office, officer, deputy or employee. Said bodies and offices, the duties, powers, purposes, responsibilities and jurisdiction of which are so transferred and vested in the department of natural resources, and the positions of all officers, deputies and employees thereunder, are and each of them is hereby abolished and shall have no further legal existence, but the statutes and laws under which they existed and all laws prescribing their duties, powers, purposes, responsibilities and jurisdiction, together with all lawful rules and regulations established thereunder are hereby expressly continued in force.

The department of natural resources shall be in possession and control of all records, books, papers, offices, equipment, supplies, moneys, funds, appropriations, land and other property real or personal now or hereafter held for the benefit or use of said bodies, offices and officers.

The boards of district oil and gas commissioners, the offices of district oil and gas commissioners and the board of review, correction and equalization created by the act approved June 10, 1915, establishing the department of petroleum and gas, are hereby respectively continued in force with the powers, duties, responsibilities and jurisdiction in them vested by the provisions of said act approved June 10, 1915, as amended; *provided*, that said board of review shall consist of the director of natural resources, the director of finance and the chairman of the state board of equalization.

373*h*. The management and control of the property acquired by the State of California under or pursuant to the provisions of the act entitled "An act to accept the gift to the state of San Pasqual battlefield in San Diego county, to provide for collecting and systematizing the history of said battle, for determining the exact location thereof, and to report a suitable method of marking said battlefield and commemorating the heroism of those Americans who fought and died there," approved May 11, 1919, is hereby transferred to and vested in the department of natural resources.

373*i*. From and after the date upon which this act takes effect, the department of natural resources shall be and is hereby authorized and empowered to expend the moneys in any appropriation or in any special fund in the state treasury now remaining or made available by law for the administration of the provisions of all the statutes the administration of which is committed to the department, or for the use, support, or maintenance of any board, bureau, commission, department, office or officer whose duties, powers, and functions are, by the provisions of this article, transferred to and conferred upon the department of natural resources. Such expenditures by the department shall be made in accordance with law in carrying out the purposes for which such appropriations were made or such special funds created.

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PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.

During the past forty-seven years, in carrying out the provisions of the organic act creating the California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the state, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have often been limited, many of the reports and bulletins mentioned were printed in limited editions which are now entirely exhausted.

Copies of such publications are available, however, in the Bureau's offices in the Ferry Building, San Francisco; New Orpheum Building, Los Angeles; Chamber of Commerce Building, Sacramento; Santa Maria; Santa Paula; Coalinga; Taft; Bakersfield. They may also be found in many public, private and technical libraries in California and other states, and foreign countries.

A catalog of all publications of the Bureau, from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the offices of the State Mining Bureau and enclosing the requisite amount in the case of publications that have a list price. The Bureau is authorized to receive only coin, stamps or money orders, and it will be appreciated if remittance is made in this manner rather than by personal check.

The prices noted include delivery charges to all parts of the United States. Money orders should be made payable to the State Mining Bureau.

REPORTS.

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**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----
**Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	----
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----
**Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	----
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Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	$1.00
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:	
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50
Mines and Mineral Resources, Del Norte, Humboldt, and Mendocino Counties, 59 pp., paper	.25
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pages, paper	----
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915:	
A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou, and Trinity Counties, 974 pp., 275 illustrations, cloth	----
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**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917:	
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Mines and Mineral Resources of Plumas County, 188 pp., paper	.50
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Seventeenth Report of the State Mineralogist, 1920, Mining in California during 1920, Fletcher Hamilton: 562 pp., 71 illustrations, cloth	1.75

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Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923 ---------- Free

Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy ---------- $0.25

Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.

January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange counties ---------- .25

April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura counties ---------- .25

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Subscription, $1.00 in advance (by calendar year, only).

Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.

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Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly.

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Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:

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**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations ----

**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps ----

**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887.) ----

**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations ----

Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston. 85 pp., 46 illustrations $0.50

**Bulletin No. 7. Mineral Production of California, by Counties for the year 1894, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 8. Mineral Production of California, by Counties for the year 1895, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896. 210 pp., 206 illustrations ----

**Bulletin No. 10. A bibliography Relating to the Geology, Palæontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp. ----

**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations ----

**Bulletin No. 12. Mineral Production of California, by Counties for 1896, by Charles G. Yale. Tabulated sheet ----

**Bulletin No. 13. Mineral Production of California, by Counties for 1897, by Charles G. Yale. Tabulated sheet ----

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**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means. 1899 ----

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**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations ----

**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps ----

**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899 ----

**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet ----

**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet ----

Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, and 9 maps .50

**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps ----

**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet ----

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**Register of Mines, with Map, El Dorado County	----
**Register of Mines, with Map, Inyo County	----
**Register of Mines, with Map, Kern County	----
**Register of Mines, with Map, Lake County	----
**Register of Mines, with Map, Mariposa County	----
**Register of Mines, with Map, Nevada County	----
**Register of Mines, with Map, Placer County	----
**Register of Mines, with Map, Plumas County	----
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**Register of Mines, with Map, San Diego County	----
Register of Mines, with Map, Santa Barbara County (1906)	$0.25
**Register of Mines, with Map, Shasta County	----
**Register of Mines, with Map, Sierra County	----
**Register of Mines, with Map, Siskiyou County	----
**Register of Mines, with Map, Trinity County	----
**Register of Mines, with Map, Tuolumne County	----
Register of Mines, with Map, Yuba County (1905)	.25
Register of Oil Wells, with Map, Los Angeles City (1906)	.35

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**Map of California, Showing Mineral Deposits (50 x 60 in.)	----
**Map of Forest Reserves in California	----
**Mineral and Relief Map of California	----
**Map of El Dorado County, Showing Boundaries, National Forests	----
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Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60
Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	.25

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These maps are revised from time to time as development work advances and ownerships change.

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Map No. 3—Santa Maria, including Casmalia and Lompoc	.75
Map No. 4—Whittier-Fullerton, including Olinda, Brea Canyon, Puente Hills, East Coyote and Richfield	.75
Map No. 5—Whittier-Fullerton, including Whittier, West Coyote, and Montebello	.75
Map No. 6—Salt Lake, Los Angeles County	.75
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DETERMINATION OF MINERAL SAMPLES.

Samples (limited to three at one time) of any mineral found in the state may b sent to the Bureau for identification, and the same will be classified free of charg No samples will be determined if received from points outside the state. It must b understood that no assays, or quantitative determinations will be made. Sample should be in lump form if possible, and marked plainly with name of sender o outside of package, etc. No samples will be received unless delivery charges ar prepaid. A letter should accompany sample, giving locality where mineral was foun and the nature of the information desired.

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